

JRC TECHNICAL REPORT

Establishing a new baseline for monitoring the status of EU Spatial Data Infrastructure

*Experiences and conclusions
from INSPIRE 2019
monitoring and reporting*

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Abstract

The INSPIRE Directive, which aims to establish a pan-European Spatial Data Infrastructure for the purposes of EU environmental policies, requires Member States to monitor and report on the implementation status on an annual basis. The way the INSPIRE monitoring and reporting process was performed in 2019 was driven by Commission Implementing Decision (EU) 2019/1372, which introduced the automated calculation of 19 new indicators through the direct use of the INSPIRE Geoportal and the INSPIRE Reference Validator to process the metadata harvested from Member States discovery services. These indicators are grouped into 5 categories: availability of spatial data and services, conformity of metadata, conformity of spatial data sets, accessibility of spatial data sets through view and download services, and conformity of network services. Most indicators are calculated as a percentage, thus providing a direct measure of performance and allowing also country-by-country comparisons. For each indicator, this report provides a detailed description of the calculation method, the values achieved for all Member States and some summary statistics to capture the overall performance trends. The results show that the status of INSPIRE implementation is very heterogeneous across the EU, with some countries performing well and some others still lagging behind. However, after 13 years from the entry into force of the Directive, there is no single country which has yet achieved full implementation according to the roadmap. The accessibility of data sets through view or download services is on average only about 30%, while the conformity of metadata, data sets and network services varies between 30% and 45% on average. In addition to providing an objective snapshot of the current status of INSPIRE implementation, the results of 2019 monitoring and reporting represent a reliable baseline to monitor the evolution of the EU Spatial Data Infrastructure and its contribution to the European Green Deal data space in the years to come.

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Executive summary

In force since 2007, the INSPIRE Directive aims to establish a pan-European Spatial Data Infrastructure (SDI) for the purposes of EU environmental policies as well as policies or activities which may have an impact on the environment. With the ultimate goal to assist policy-making across boundaries, INSPIRE facilitates public access to environmental spatial information and fosters data sharing among public sector organisations in Europe. The role of INSPIRE is still central in the current European policy context for the establishment of the Green Deal data space, envisioned by the European strategy for data as a data ecosystem for environment and sustainability. The European SDI established by INSPIRE is based on the national SDIs of the European Union (EU) Member States and the European Free Trade Association (EFTA) countries, which are required to identify and document the relevant spatial data sets, and make them discoverable and accessible through a set of interoperable network services. In addition, the Directive requires Member States and EFTA countries to monitor and report on the status of implementation of their national SDIs on an annual basis.

Until 2018 INSPIRE monitoring and reporting was based on 48 indicators, calculated from the information that countries provided using tools such as web forms and dashboards, made available by the European Environment Agency (EEA). The purpose of this report is to describe the process and results of the INSPIRE 2019 monitoring and reporting, the first based on Commission Implementing Decision (EU) 2019/1372, which introduced a new set of only 19 performance indicators. For the first time in the Directive lifecycle, the process was managed by the JRC and fully automated through the use of the INSPIRE Geoportal and the INSPIRE Reference Validator software tools. This objective and transparent methodology has ushered in a new way to measure the status of implementation of the European SDI established by the INSPIRE Directive. The report, which targets an audience familiar with the INSPIRE implementation process (data providers and implementers, managers responsible at the national or regional level, and users) describes each indicator, its calculation method, the values achieved by each country and some summary statistics to capture the overall performance trends.

The results of the INSPIRE 2019 monitoring and reporting show that the status of implementation of INSPIRE is heterogeneous across countries, and there is no single country which has yet achieved full implementation although most of the deadlines have already passed. Despite significant differences in the values of the indicators across countries, the average performance is relatively low. Less than a third of the existing data is actually accessible through view and download services, which limits the usability of the infrastructure. The fraction of conformant metadata is also low (around 35%) and similar results are found for the conformity of spatial data sets and network services, with some countries providing few or no interoperable resources at all.

While showing that the INSPIRE implementation process is still in progress, with some few countries clearly lagging behind, the results of 2019 monitoring and reporting also represent a reliable baseline for monitoring the status and the evolution of the EU SDI in the years to come. The fact that the new procedure was well received by the countries, which – in a spirit of collaborative interaction with the European Commission – already identified the existing weaknesses, raises high expectations for a significant future improvement and an increasing impact on the implementation of INSPIRE in light of the next monitoring and reporting rounds and the forthcoming evaluation of the Directive foreseen in 2022.

1 Introduction and policy context

The general objective of Directive 2007/2/EC or **INSPIRE Directive** (European Union, 2007) is to establish the Infrastructure for Spatial Information in the European Community for the purposes of European Union (EU) **environmental policies** as well as policies or activities which may have an impact on the environment. This European Spatial Data Infrastructure (SDI) is based on the national SDIs established and operated by the EU Member States and the European Free Trade Association (EFTA) countries (hereafter collectively referred to as 'member countries', or simply 'countries') and shall enable the sharing of environmental spatial information between public sector organisations and facilitate public access to spatial information across the EU. In a nutshell, the INSPIRE Directive requires member countries to identify the relevant spatial data sets, document them through metadata and make them discoverable and available through interoperable network services.

Among other things, the Directive also requires member countries to monitor the implementation and use of their SDIs and to report on a number of issues related to this. The INSPIRE **monitoring and reporting** is an annual process, whose results shall be published by March 31st of each year at the latest with reference to the status of the implementation of the infrastructure on December 15th of the preceding year. The recent Commission Implementing Decision (EU) 2019/1372 (European Commission, 2019) was introduced to simplify and streamline INSPIRE monitoring and reporting and establish a new baseline for monitoring the status of the EU SDI. It substitutes the existing Commission Decision 2009/442/EC (European Commission, 2009a) by implementing the INSPIRE Directive as regards monitoring and reporting. More in detail, it establishes that monitoring and reporting is performed through a set of **indicators** to be calculated based on the metadata collected from member countries public authorities. These indicators measure the implementation progress of the Directive in the member countries and are used to evaluate the success against its objectives.

In accordance to Article 5 of the INSPIRE Directive and as required by Commission Decision (EU) 2019/1372, to minimize the administrative burden of monitoring and reporting, the indicators shall be calculated based on the **metadata for spatial data sets and spatial data services** published by member countries. Metadata that exist but have not been published in the registered discovery services of member countries are not discoverable and do not contribute to the INSPIRE infrastructure; hence they are not taken into account when calculating the monitoring and reporting indicators. The responsibility to monitor the implementation and use of the member countries infrastructures for spatial information is with the countries themselves, as stated in Article 21(1) of the INSPIRE Directive. However, the member countries and the European Commission agreed on the use of a centralised common infrastructure to limit the administrative burden on the member countries for calculating indicators and publishing the monitoring and reporting results. This is available as part of the INSPIRE knowledge base ⁽¹⁾ hosted by the JRC and providing full transparency on the calculation methods. Member countries are free to decide whether to use this common infrastructure or not.

In contrast to the previous Commission Decision 2009/442/EC, which envisaged 48 indicators (Monitoring and Reporting Drafting Team and European Commission - Eurostat), the new Commission Decision (EU) 2019/1372 reduces the amount of indicators to 19. This reduction is partially resulting from the automated reuse of metadata as the source for calculating indicators and partially from the outcome of reviewing and rationalising the indicators in the light of core information needs to monitor the INSPIRE implementation status and progress. Also, the high number of previous indicators did not allow for a clear insight into the implementation progress. There were too many indicators and not necessarily the right ones. For example, the absolute number of spatial data sets made available by member countries under the INSPIRE Directive is not necessarily a good indicator to assess the implementation, since the types of data sets may vary (in coverage, scale, quality, etc.) and are not comparable between countries. For example, the availability of (few) nationwide data sets might be a sign of a higher level of maturity compared to the availability of only a large number of regional or local data sets. The previous set of indicators did not allow to identify these differences in implementation.

In contrast, the indicators introduced by the new Commission Decision measure not only the number of spatial data sets that are being used for reporting under the environmental acquis but also the distribution of such **spatial data sets with regional and national coverage**. For these indicators, member countries are required to include specific keywords derived from a common vocabulary ⁽²⁾ in their data set metadata. In addition to supplying evidence for the indicators, the use of such common keywords – which allow to identify the national or regional reference data sets for the given theme(s) or spatial object type(s) – provides a simple methodology to filter specific data sets with high reuse value for both national and European use

⁽¹⁾ <https://inspire.ec.europa.eu>

⁽²⁾ <https://inspire.ec.europa.eu/metadata-codelist/SpatialScope>

cases. Depending on the constitutional setup in the member country and the distribution of competences, the following three main scenarios for tagging data sets with regional/national keywords are identified:

- nationally organised data sets (produced by a national administration) are available: these are tagged with the “national” keyword;
- only regional data sets are available, but no national data sets: for every region, the regional data set is tagged with the “regional” keyword;
- both nationally organised data sets and regional data sets are available with the same level of detail. A member country has regional data sets but also creates a national data set. The latter is tagged with the “national” keyword, while the regional data sets are tagged with the “regional” keyword.

With the Regulation (EU) 2019/1010 (European Union, 2019a) member countries are exempted from drafting the full implementation report every three years as it was originally required in the INSPIRE Directive. Instead, the relevant information has to be provided online in the INSPIRE knowledge base when changes occur in the governance of the national SDIs as part of the country fiche ⁽³⁾. The content of the report should be organised in this country fiche in a way that brings together monitoring and reporting information in a meaningful country overview. The country fiche template and the structured information provision limits the occurrence of non-structured textual information and streamlines the content to reflect a similar approach and comparable results across member countries and for trend analysis.

Until 2018, the INSPIRE monitoring and reporting process was managed by the European Environment Agency (EEA). Member countries formally submitted the monitoring and reporting information (used to calculate the indicators) through ReportNet, the electronic infrastructure of the EEA for data collection, operational since 2002. Starting from 2015, the monitoring and reporting process was supported by a new series of tools from the EEA (web forms and dashboards) which were developed to simplify and automate as much as possible the creation of the INSPIRE monitoring file. Member countries could indeed generate this file using two operational workflows, i.e. either by manually filling in the web form available in ReportNet or by retrieving information automatically from their INSPIRE national discovery services (catalogues) harvested using the INSPIRE Dashboard ⁽⁴⁾ sandbox. Overall, the monitoring and reporting information was provided by member countries in a decentralized way and partially through manual procedures, making it difficult to compare the calculated indicators in a consistent way.

This report provides an overview of the **INSPIRE 2019 monitoring and reporting process and outcomes**, based for the first time on the requirements of Commission Decision (EU) 2019/1372. It describes the new infrastructure and process developed by the JRC and explains the workflow from metadata harvesting and validation, calculation of the indicators up to the visualization of results in the country fiches. In contrast to the past, the process – which makes use of the INSPIRE Geoportal ⁽⁵⁾ the INSPIRE Reference Validator ⁽⁶⁾ – is **fully automated** and is performed with an improved transparency and in close collaboration with member countries stakeholders and other Commission services. Thus, the results of the process represent a new and reliable baseline for the assessment of the status of the EU SDI and its evolution in the following years. In addition, monitoring the improvement in INSPIRE data availability and accessibility is of crucial importance for the **European Green Deal data space**, the sectoral data space for the environment envisioned by the recent European strategy for data (European Commission, 2020) in support of the Green Deal priority actions of the European Commission.

The remainder of the report is structured as follows. Section 2 describes the scope and process of the 2019 monitoring and reporting activity in detail, presenting the 19 indicators introduced by Commission Decision (EU) 2019/1372 and describing the software and procedures used to calculate them and to publish the monitoring and reporting results, including the update of country fiches. Section 3 presents the quantitative results, i.e. the calculated values of the indicators for all member countries. Section 4 concludes the report by summarizing the current status of the EU Spatial Data Infrastructure, discussing the major trends existing across the EU, and highlighting the achievements made and the issues to be addressed in the years to come.

⁽³⁾ <https://inspire.ec.europa.eu/INSPIRE-in-your-Country>

⁽⁴⁾ <https://inspire-dashboard.eea.europa.eu>

⁽⁵⁾ <https://inspire-geoportal.ec.europa.eu>

⁽⁶⁾ <https://inspire.ec.europa.eu/validator/about>

2 2019 Monitoring and reporting: scope and process

2.1 Indicators

The 19 monitoring indicators are grouped into the 5 categories established in the Commission Decision (EU) 2019/1372:

- monitoring of the availability of spatial data and services (Art. 3);
- monitoring of the conformity of metadata with Commission Regulation (EC) No 1205/2008 (European Commission, 2008) (Art. 4);
- monitoring of the conformity of spatial data sets with Commission Regulation (EU) No 1089/2010 (European Commission, 2010) on interoperability (Art. 5);
- monitoring of the accessibility of spatial data sets through view and download services (Art. 6);
- monitoring of the conformity of network services with Commission Regulation (EC) No 976/2009 (European Commission, 2009b) (Art. 7);

For each of these 5 categories, the following subsections (from 2.1.1 to 2.1.5) introduce the single indicators providing their definition, description and calculation method.

2.1.1 Monitoring of the availability of spatial data and services

The indicators DSi1.1, DSi1.2, DSi1.3, DSi1.4 and DSi1.5 are described in Table 1 to Table 5.

Table 1. Description of indicator DSi1.1

Indicator	DSi1.1
Definition	The number of spatial data sets for which metadata exist
Description	The number of data set metadata records, published by member countries through their discovery services, corresponding to the themes listed in Annexes I, II and III to Directive 2007/2/EC.
Calculation method	The indicator represents the amount of all data set metadata records published by the member countries in their registered discovery services. Member countries should check that there are no duplicate records and that the INSPIRE Geoportal is showing all of the records. For the calculation, metadata records of data set series will also be included. At the EU level, this indicator is calculated as the sum of all member countries data set metadata records.

Table 2. Description of indicator DSi1.2

Indicator	DSi1.2
Definition	The number of spatial data services for which metadata exist
Description	The number of spatial data services published by member countries through their discovery services.
Calculation method	This is the amount of spatial data services metadata available in the registered discovery services of the member countries. At the EU level, this indicator is calculated as the sum of all member countries service metadata records in their registered discovery services or service access point definitions in data set metadata records.

Table 3. Description of indicator DSi1.3

Indicator	DSi1.3
Definition	The number of spatial data sets for which the metadata contains one or more keywords from a register provided by the Commission indicating that the spatial data set is used for reporting under the environmental legislation
Description	The number of spatial data set metadata records that contain one or more keywords of the priority list of spatial data sets.
Calculation method	This is the number of metadata records where one or more priority data set keywords from the INSPIRE Metadata code list register ⁽⁷⁾ is provided in the metadata "Keyword" element. Additional guidelines on the tagging of metadata are provided by the MIG subgroup 2016.5 on priority data sets for e-Reporting ⁽⁸⁾ . At the EU level, this indicator is calculated as the sum of all member countries relevant metadata records.

Table 4. Description of indicator DSi1.4

Indicator	DSi1.4
Definition	The number of spatial data sets for which the metadata contains a keyword from a register provided by the Commission indicating that the spatial data set covers regional territory
Description	The number of spatial data set metadata records that contain a keyword "Regional".
Calculation method	This is the amount of metadata records where a keyword "Regional" is provided in the metadata "Keyword" element. The keyword to be used is a value of the spatial scope code list of the INSPIRE Metadata code list register ⁽⁹⁾ . Guidelines on how to add this keyword into the metadata have been made available ⁽¹⁰⁾ . At the EU level, this indicator is calculated as the sum of all member countries relevant metadata records.

Table 5. Description of indicator DSi1.5

Indicator	DSi1.5
Definition	The number of spatial data sets for which the metadata contains a keyword from a register provided by the Commission indicating that the spatial data set covers the national territory
Description	The number of spatial data set metadata records that contain a keyword "National".
Calculation method	This is the amount of metadata records where a keyword "National" is provided in the metadata "Keyword" element. The keyword to be used is a value of the spatial scope code list of the INSPIRE Metadata code list register. Guidelines on how to add this keyword into the metadata have been made available (see the description of indicator DSi1.4). At the EU level, this indicator is calculated as the sum of all member countries relevant metadata records.

⁽⁷⁾ <http://inspire.ec.europa.eu/metadata-codelist/PriorityDataset>

⁽⁸⁾ <https://ies-svn.jrc.ec.europa.eu/projects/2016-5/wiki/Implementation>

⁽⁹⁾ <https://inspire.ec.europa.eu/metadata-codelist/SpatialScope>

⁽¹⁰⁾ <https://webgate.ec.europa.eu/fpfis/wikis/display/InspireMIG/Spatial+scope+code+list>

2.1.2 Monitoring of the conformity of metadata with Regulation (EC) No 1205/2008

The indicators MDi1.1 and MDi1.2 are described in Table 6 and Table 7.

Table 6. Description of indicator MDi1.1

Indicator	MDi1.1
Definition	Percentage of metadata for spatial data sets conformant with Commission Regulation (EC) No 1205/2008 as regards metadata
Description	The number of spatial data sets for which metadata are in conformity with Regulation (EC) No 1205/2008 multiplied by a hundred and divided by the number of spatial data sets for which metadata exist as given by indicator DSi1.1.
Calculation method	This is the number of data set metadata, published in the INSPIRE Geoportal, that are in conformance with Regulation (EC) No 1205/2008. Metadata that do not satisfy the requirements laid down by Regulation (EC) No 1205/2008 will be considered non-conformant metadata. The conformity of the metadata is assessed centrally and automatically by the Commission with the INSPIRE Reference Validator, using the commonly agreed conformance tests (see subsection 2.2.3). This assessment is performed on the metadata snapshot from member countries discovery services made on 15 December. The indicator is calculated based on the validation results of the Reference Validator. Member countries are encouraged to regularly use the INSPIRE Reference Validator for testing the conformity of their metadata records. At the EU level, this indicator is calculated as the average of all member countries.

Table 7. Description of indicator MDi1.2

Indicator	MDi1.2
Definition	Percentage of metadata for spatial data services conformant with Commission Regulation (EC) No 1205/2008 as regards metadata
Description	The number of spatial data services for which metadata are in conformity with Regulation (EC) No 1205/2008 multiplied by a hundred and divided by the number of spatial data services for which metadata exist as given by indicator DSi1.2.
Calculation method	This is the amount of service metadata published in the INSPIRE Geoportal that are in conformity with Regulation (EC) No 1205/2008. Further technical implementation details for the possible service metadata scenarios are described in technical guidance documents. Metadata that do not satisfy the requirements laid down by Regulation (EC) No 1205/2008 will be considered non-conformant. The conformity of the metadata is assessed centrally and automatically by the Commission with the INSPIRE Reference Validator, using the commonly agreed conformance tests (see subsection 2.2.3). This assessment is performed on the metadata snapshot from member countries discovery services made on 15 December. The indicator is calculated based on the validation results of the Reference Validator. Member countries are encouraged to regularly use the INSPIRE Reference Validator for testing the conformity of their metadata records. At the EU level, this indicator is calculated as the average of all member countries.

2.1.3 Monitoring of the conformity of spatial data sets with Commission Regulation (EU) No 1089/2010 on interoperability

The indicators DSi2, DSi2.1, DSi2.2 and DSi2.3 are described in Table 8 to Table 11.

Table 8. Description of indicator DSi2

Indicator	DSi2
Definition	Percentage of spatial data sets that are in conformity with Commission Regulation (EU) No 1089/2010 as regards interoperability of spatial data sets
Description	The number of spatial data sets which are in conformity with Regulation (EU) No 1089/2010 multiplied by a hundred and divided by the number of spatial data sets as given by indicator DSi1.1.
Calculation method	This is the amount of all metadata data set records published by member countries with conformity statement expressing the conformity with Regulation (EU) No 1089/2010 in the "Conformity" metadata element, see subsection 2.4.1 of metadata Technical Guidance (TG) v. 2.0 (Temporary MIG subgroup for action MIWP-8, 2017). Member countries are encouraged to regularly use the INSPIRE Reference Validator for testing the conformity of their spatial data sets. The Commission might use the Reference Validator to assess the actual conformity of a sample of member countries resources declared as conformant. At the EU level, this indicator is calculated as the average of all member countries.

Table 9. Description of indicator DSi2.1

Indicator	DSi2.1
Definition	Percentage of spatial data sets, corresponding to the themes listed in Annex I, that are in conformity with Commission Regulation (EU) No 1089/2010 as regards interoperability of spatial data sets
Description	The number of spatial data sets corresponding to the themes listed in Annex I of Directive 2007/2/EC which are in conformity with Regulation (EU) No 1089/2010, multiplied by a hundred and divided by the number of spatial data sets corresponding to the themes listed in that Annex.
Calculation method	This is the amount of metadata data set records published by member countries, which contain a keyword in the metadata element "Keyword" indicating that the data set belongs to a theme from Annex I, with conformity statement expressing the conformity with Regulation (EU) No 1089/2010 in the "Conformity" metadata element. Member countries are encouraged to regularly use the INSPIRE Reference Validator for testing the conformity of their spatial data sets. The Commission might use the Reference Validator to assess the actual conformity of a sample of member countries resources declared as conformant. At the EU level, this indicator is calculated as the average of all member countries.

Table 10. Description of indicator DSi2.2

Indicator	DSi2.2
Definition	Percentage of spatial data sets, corresponding to the themes listed in Annex II, that are in conformity with Commission Regulation (EU) No 1089/2010 as regards interoperability of spatial data sets
Description	The number of spatial data sets corresponding to the themes listed in Annex II of Directive 2007/2/EC which are in conformity with Regulation (EU) No 1089/2010, multiplied by a hundred and divided by the number of spatial data sets corresponding to the themes listed in

	that Annex.
Calculation method	This is the amount of metadata data set records published by member countries, which contain a keyword in the metadata element "Keyword" indicating that the data set belongs to a theme from Annex II, with conformity statement expressing the conformity with Regulation (EU) No 1089/2010 in the "Conformity" metadata element. Member countries are encouraged to regularly use the INSPIRE Reference Validator for testing the conformity of their spatial data sets. The Commission might use the Reference Validator to assess the actual conformity of a sample of member countries resources declared as conformant. At the EU level, this indicator is calculated as the average of all member countries.

Table 11. Description of indicator DSi2.3

Indicator	DSi2.3
Definition	Percentage of spatial data sets, corresponding to the themes listed in Annex III, that are in conformity with Commission Regulation (EU) No 1089/2010 as regards interoperability of spatial data sets
Description	The number of spatial data sets corresponding to the themes listed in Annex III of Directive 2007/2/EC which are in conformity with Regulation (EU) No 1089/2010, multiplied by a hundred and divided by the number of spatial data sets corresponding to the themes listed in that Annex.
Calculation method	This is the amount of metadata data set records published by member countries, which contain a keyword in the metadata element "Keyword" indicating that the data set belongs to a theme from Annex III, with conformity statement expressing the conformity with Regulation (EU) No 1089/2010 in the "Conformity" metadata element. Member countries are encouraged to regularly use the INSPIRE Reference Validator for testing the conformity of their spatial data sets. The Commission might use the Reference Validator to assess the actual conformity of a sample of member countries resources declared as conformant. At the EU level, this indicator is calculated as the average of all member countries.

2.1.4 Monitoring of the accessibility of spatial data sets through view and download services

The indicators NSi2, NSi2.1 and NSi2.2 are described in Table 12 to Table 14.

Table 12. Description of indicator NSi2

Indicator	NSi2
Definition	The percentage of spatial data sets that are accessible through view and download services
Description	The number of spatial data sets for which both view and download services exist, multiplied by a hundred and divided by the number of spatial data sets as given by indicator DSi1.1.
Calculation method	The sum of all data sets that are indicated as both viewable and downloadable in the Geoportal is divided by the sum of the data sets for which metadata are published in the Geoportal (DSi1.1). Building on the existing guidelines, a document has been provided to clarify how the linkages between the services and data sets are established in metadata ⁽¹¹⁾ . At the EU level, this indicator is calculated as the average of all member countries.

⁽¹¹⁾ https://inspire-geoportal.ec.europa.eu/files/INSPIRE_Geoportal_process_for_data-service_linking_v1.0.pdf

Table 13. Description of indicator NSi2.1

Indicator	NSi2.1
Definition	The percentage of spatial data sets that are accessible through view services
Description	The number of spatial data sets for which a view service exists, multiplied by a hundred and divided by the number of spatial data sets as given by indicator DSi1.1.
Calculation method	The sum of all data sets that are indicated as viewable in the Geoportal is divided by the sum of the data sets for which metadata is published in the Geoportal (DSi1.1). At the EU level, this indicator is calculated as the average of all member countries.

Table 14. Description of indicator NSi2.2

Indicator	NSi2.2
Definition	The percentage of spatial data sets that are accessible through download services
Description	The number of spatial data sets for which a download service exists, multiplied by a hundred and divided by the number of spatial data sets as given by indicator DSi1.1.
Calculation method	The sum of all data sets that are indicated as downloadable in the Geoportal is divided by the sum of the data sets for which metadata is published in the Geoportal (DSi1.1). At the EU level, this indicator is calculated as the average of all member countries.

2.1.5 Monitoring of the conformity of network services with Regulation (EC) No 976/2009

The indicators NSi4, NSi4.1, NSi4.2, NSi4.3 and NSi4.4 are described in Table 15 to Table 19.

Table 15. Description of indicator NSi4

Indicator	NSi4
Definition	The percentage of the network services that are in conformity with Commission Regulation (EC) No 976/2009 as regards the network services
Description	The number of network services which are in conformity with Regulation (EC) No 976/2009, multiplied by a hundred and divided by the total number of network services.
Calculation method	For this indicator only discovery, view, download and transformation network services are taken into account. The identification of the type of network services is done based on the "spatial data service type" metadata element when service metadata is provided, based on the definition of the service access points if these service access points are defined in data set metadata and based on the registered service endpoints for discovery network services. The conformity with Regulation (EU) No 976/2009 should be expressed in the "Conformity" metadata element, see subsection 2.4.1 of metadata TG v. 2.0 (Temporary MIG subgroup for action MIWP-8, 2017). Member countries are encouraged to regularly use the INSPIRE Reference Validator for testing the conformity of their network services. The Commission might use the Reference Validator to assess the actual conformity of a sample of member countries resources declared as conformant. At the EU level, this indicator is calculated as the average of all member countries.

Table 16. Description of indicator NSi4.1

Indicator	NSi4.1
Definition	The percentage of the discovery services that are in conformity with Commission Regulation (EC) No 976/2009 as regards the network services
Description	The number of discovery services which are in conformity with Regulation (EC) No 976/2009, multiplied by a hundred and divided by the total number of discovery services.
Calculation method	For this indicator only discovery network services that are registered by the member countries are taken into account. The conformity with Regulation (EU) No 976/2009 should be expressed in the "Conformity" metadata element. Member countries are encouraged to regularly use the INSPIRE Reference Validator for testing the conformity of their network services. The Commission might use the Reference Validator to assess the actual conformity of a sample of member countries resources declared as conformant. At the EU level, this indicator is calculated as the average of all member countries.

Table 17. Description of indicator NSi4.2

Indicator	NSi4.2
Definition	The percentage of the view services that are in conformity with Commission Regulation (EC) No 976/2009 as regards the network services
Description	The number of view services which are in conformity with Regulation (EC) No 976/2009, multiplied by a hundred and divided by the total number of view services.
Calculation method	For this indicator only view network services are taken into account. The identification of the type of network services is done based on the "spatial data service type" metadata element when service metadata is provided or based on the definition of the service access points if these service access points are defined in data set metadata. Statement in metadata should express the conformity with Regulation (EU) No 976/2009 in the "Conformity" metadata element. Member countries are encouraged to regularly use the INSPIRE Reference Validator for testing the conformity of their network services. The Commission might use the Reference Validator to assess the actual conformity of a sample of member countries resources declared as conformant. At the EU level, this indicator is calculated as the average of all member countries.

Table 18. Description of indicator NSi4.3

Indicator	NSi4.3
Definition	The percentage of the download services that are in conformity with Commission Regulation (EC) No 976/2009 as regards the network services
Description	The number of download services which are in conformity with Regulation (EC) No 976/2009, multiplied by a hundred and divided by the total number of download services.
Calculation method	For this indicator only download network services are taken into account. The identification of the type of network services is done based on the "spatial data service type" metadata element when service metadata is provided or based on the definition of the service access points if these service access points are defined in data set metadata. Statement in metadata should express the conformity with Regulation (EU) No 976/2009 in the "Conformity"

	metadata element. Member countries are encouraged to regularly use the INSPIRE Reference Validator for testing the conformity of their network services. The Commission might use the Reference Validator to assess the actual conformity of a sample of member countries resources declared as conformant. At the EU level, this indicator is calculated as the average of all member countries.
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Table 19. Description of indicator NSi4.4

Indicator	NSi4.4
Definition	The percentage of the transformation services that are in conformity with Commission Regulation (EC) No 976/2009 as regards the network services
Description	The number of transformation services which are in conformity with Regulation (EC) No 976/2009, multiplied by a hundred and divided by the total number of transformation services.
Calculation method	For this indicator only transformation network services are taken into account. The identification of the type of network services is done based on the "spatial data service type" metadata element when service metadata is provided or based on the definition of the service access points if these service access points are defined in data set metadata. Statement in metadata should express the conformity with Regulation (EU) No 976/2009 in the "Conformity" metadata element. Member countries are encouraged to regularly use the INSPIRE Reference Validator for testing the conformity of their network services. The Commission might use the Reference Validator to assess the actual conformity of a sample of member countries resources declared as conformant. At the EU level, this indicator is calculated as the average of all member countries.

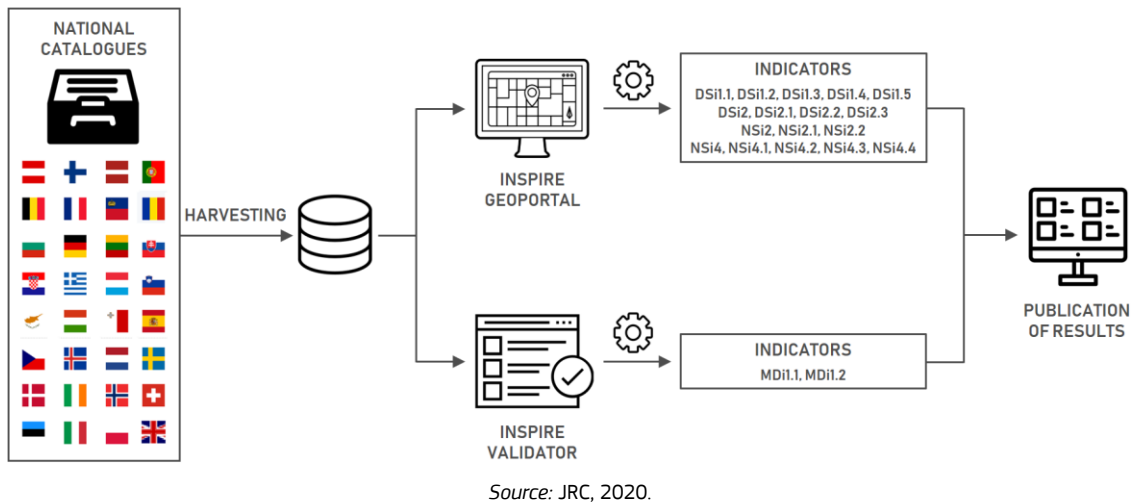
2.2 Process and system integration

Figure 1 provides a schematic illustration of the workflow performed within the 2019 monitoring and reporting process to calculate the values of the 19 indicators foreseen by Commission Decision 2019/1372. At a high level, the process involves four steps:

1. The harvest of resources from member countries discovery services (national catalogues);
2. The calculation of the indicators relevant to the availability of spatial data sets and services (DSi1.1, DSi1.2, DSi1.3, DSi1.4, DSi1.5), conformity of spatial data sets (DSi2, DSi2.1, DSi2.2, DSi2.3), accessibility of spatial data sets (NSi2, NSi2.1, NSi2.2) and conformity of network services (NSi4, NSi4.1, NSi4.2, NSi4.3, NSi4.4) using the INSPIRE Geoportal;
3. The calculation of the indicators relevant to the conformity of metadata (MDi1.1, MDi1.2) using the INSPIRE Reference Validator;
4. The online publication of results for each member country, including the values of all indicators and the update of country fiches.

The four steps are described in more detail in the following subsections (from 2.2.1 to 2.2.4).

Figure 1. Schematic illustration of the 2019 monitoring and reporting process

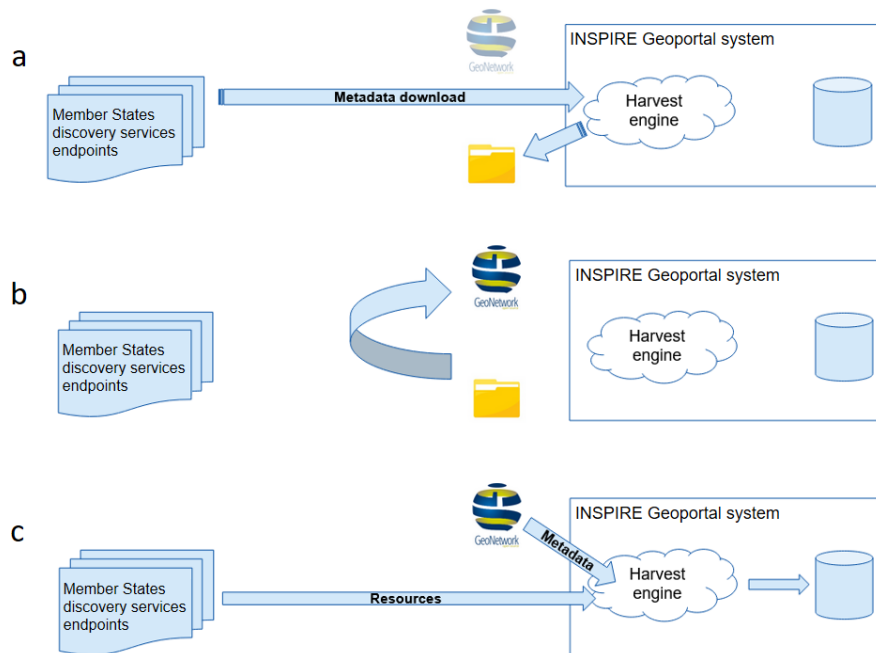


2.2.1 Harvesting

The harvesting process was carried out in two distinct phases:

1. Download of all the metadata records from the member countries discovery services endpoints into the Geoportal system (see Figure 2a): only the metadata records provided by the registered endpoints were downloaded. The full harvest with those metadata records was carried out in a second stage (see below).
2. Data harvesting and processing: the downloaded metadata records were loaded in a local instance of GeoNetwork⁽¹²⁾ (see Figure 2b); a full harvest was then performed on this endpoint by the Geoportal harvesting system, and all the resources (service availability, resource linkages, view and download data accessibility) were processed (see Figure 2c). GeoNetwork was used to facilitate the processing of the initially downloaded metadata.

Figure 2. Steps to harvest the member countries discovery services endpoints: download metadata records (a); load metadata records in a local instance of GeoNetwork (b); and perform the harvest of this instance (c)

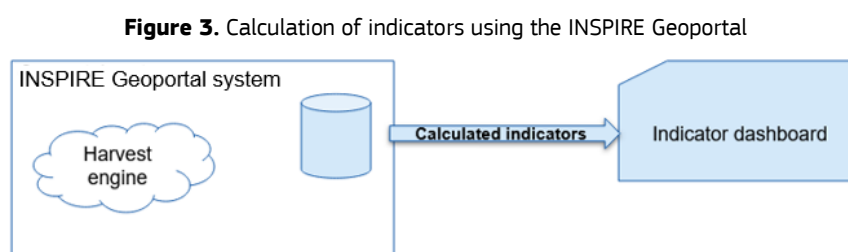


Source: JRC, 2020.

⁽¹²⁾ <https://geonetwork-opensource.org>

2.2.2 Calculation of indicators using the INSPIRE Geoportal

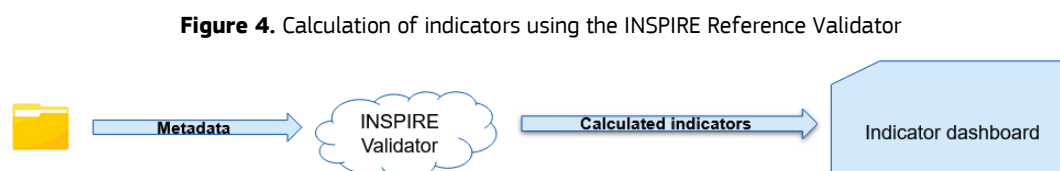
As mentioned in section 2.2, the INSPIRE Geoportal was used to calculate the indicators relevant to the **availability, accessibility and conformity of spatial data sets and network services**. The metadata records harvested from member countries discovery services were processed to calculate the indicators DSi1.1, DSi1.2, DSi1.3, DSi1.4, DSi1.5, DSi2, DSi2.1, DSi2.2, DSi2.3, NSi2, NSi2.1, NSi2.2, NSi4, NSi4.1, NSi4.2, NSi4.3 and NSi4.4 according to the calculation methods described in subsections 2.1.1, 2.1.3, 2.1.4 and 2.1.5 (see Figure 3). The accessibility of member countries spatial data sets, measured by the indicators NSi2, NSi2.1 and NSi2.2, was determined using the INSPIRE Geoportal through the establishment of **linkages between the metadata of spatial data sets and those of spatial data services** (in particular view and download services), both harvested from member countries discovery services. If linkages were found for a data set, this was classified as viewable and/or downloadable. The procedure used by the INSPIRE Geoportal to establish linkages between spatial data sets and services is out of scope for this report and is explained in a dedicated document ⁽¹³⁾. INSPIRE data providers can check whether the linkages between their data sets and spatial data services can be established by the INSPIRE Geoportal using the resource linkages checker tool ⁽¹⁴⁾. For all member countries, the indicators calculated using the Geoportal were finally displayed in the indicator dashboard (see subsection 2.2.4).



Source: JRC, 2020.

2.2.3 Calculation of indicators using the INSPIRE Reference Validator

As mentioned in section 2.2, the INSPIRE Reference Validator was used to calculate the indicators relevant to the **conformity of metadata** (MDi1.1 and MDi1.2) according to the calculation methods described in subsection 2.1.2 (see Figure 4). For all the member countries, the indicators calculated using the INSPIRE Reference Validator were finally displayed in the indicator dashboard (see subsection 2.2.4).



Source: JRC, 2020.

Funded by the ELISE Action ⁽¹⁵⁾ of the ISA² Programme ⁽¹⁶⁾, the INSPIRE Reference Validator is the central component used by data providers, solution providers and member countries national coordinators to check whether data sets, network services and metadata meet the requirements defined in the INSPIRE TG documents. For each type of resource, tests are organized into Executable Test Suites (ETS), which represent a machine-executable description of tests. In turn ETS derive from Abstract Test Suites (ATS), which consist of high-level (abstract) translations of the TG requirements into tests. For each type of resource, ATS and ETS are formed by a number of conformance classes. All the tests included in the INSPIRE Reference Validator are agreed by the technical sub-group of the INSPIRE Maintenance and Implementation Group (MIG-T). The

⁽¹³⁾ https://inspire-geoportal.ec.europa.eu/files/INSPIRE_Geoportal_process_for_data-service_linking_v1.0.pdf

⁽¹⁴⁾ <https://inspire-geoportal.ec.europa.eu/linkagechecker.html>

⁽¹⁵⁾ https://ec.europa.eu/isa2/actions/elise_en

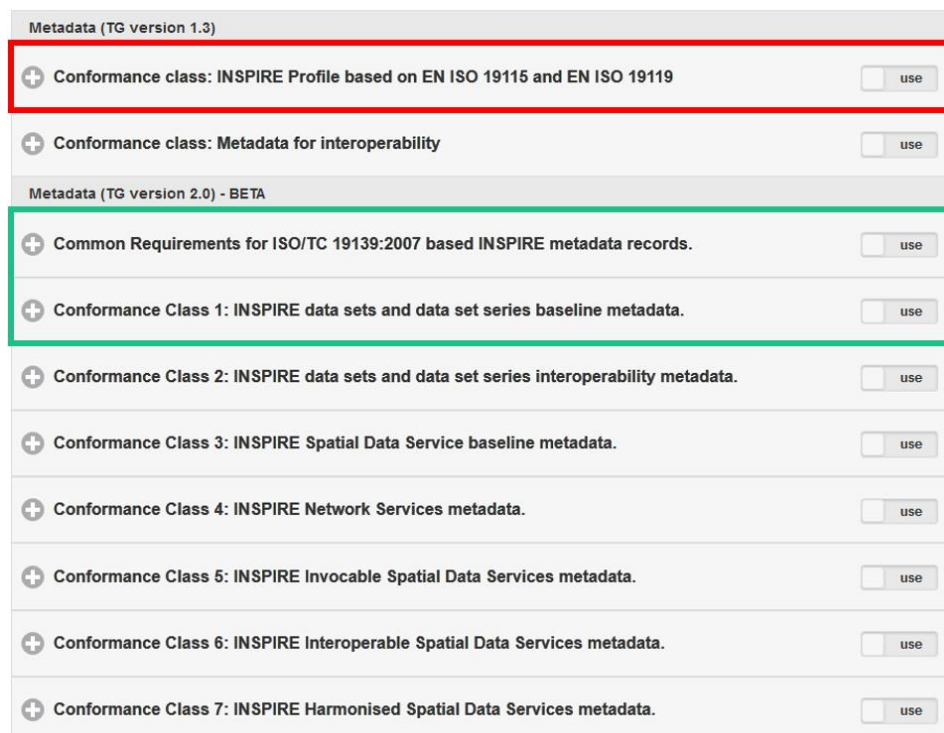
⁽¹⁶⁾ <https://ec.europa.eu/isa2>

INSPIRE Reference Validator is based on the open source ETF testing framework ⁽¹⁷⁾, which is the software where INSPIRE ETS are run.

The result of a test run in the INSPIRE Reference Validator is a test report, where all the tests performed (belonging to the conformance classes tested) are listed (with links to the corresponding ATS) and the outcome of each test is indicated. For the tests that fail validation, an explanation of the error is provided so that the user can more easily spot the mistakes in the metadata and fix them. The test report can be downloaded in both the HTML and JSON formats. The main outcomes of the whole validation are 'passed', when all the tests belonging to all the conformance classes tested pass, and 'failed', when at least one test belonging to any of the conformance classes tested fails. However, some requirements from the INSPIRE TG cannot be tested automatically and so are the corresponding tests in the INSPIRE Reference Validator. Thus, the outcome of such tests does only depend on the user's manual check. If a validation only includes tests that pass and tests that depend on a manual check by the user, the outcome of the validation returned by the INSPIRE Reference Validator is 'passed manual'. For the purposes of 2019 monitoring and reporting, a 'passed manual' outcome was considered equivalent to a 'passed' outcome.

The indicators MDi1.1 and MDi1.2 express the percentage of conformity of metadata for spatial data sets and metadata for spatial data services, respectively. The TG from which the tests are derived have two versions: TG v. 1.3, published in 2007 and revised in 2013 (Drafting Team Metadata and European Commission Joint Research Centre, 2013) and TG v. 2.0 (Temporary MIG subgroup for action MIWP-8, 2017), published in 2017. TG v. 2.0 was introduced to replace TG v. 1.3 starting from December 19, 2019, with a transitional period of 3 years (starting from December 19, 2016) left to data providers to facilitate a smooth transition. For the 2019 monitoring and reporting process, which (as mentioned in section 1) was based on the resources made available by member countries on December 15, 2019, **it was agreed to still accept metadata encoded according to TG v. 1.3**. The conformance classes used in the INSPIRE Reference Validator to test the conformity of metadata for spatial data sets and spatial data services, for TG v. 1.3 and TG v. 2.0, are listed in Figures 5 and 6, respectively. These figures show the portion of the web interface of the INSPIRE Reference Validator ⁽¹⁸⁾ about metadata tests.

Figure 5. Portion of the web interface of the INSPIRE Reference Validator showing the conformance classes used in 2019 monitoring and reporting to check the conformity of metadata for spatial data sets for TG v. 1.3 (red) and TG v. 2.0 (green)

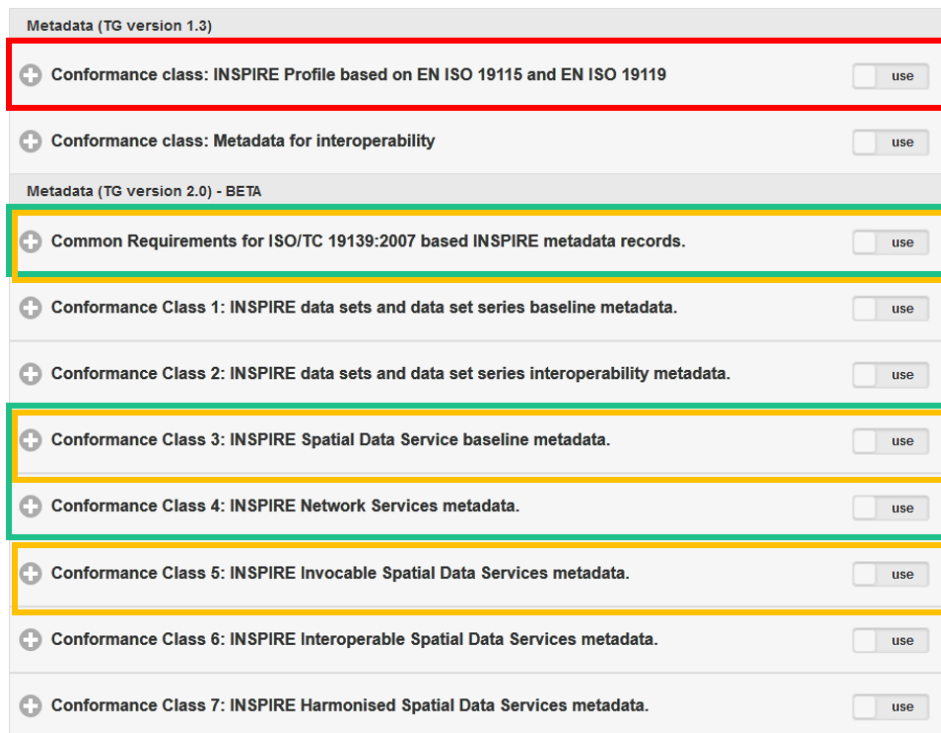


Source: JRC, 2020.

⁽¹⁷⁾ <https://etf-validator.net>

⁽¹⁸⁾ <https://inspire.ec.europa.eu/validator>

Figure 6. Portion of the web interface of the INSPIRE Reference Validator showing the conformance classes used in 2019 monitoring and reporting to check the conformity of metadata for spatial data services for TG v. 1.3 (red) and TG v. 2.0 network services (green) and invocable spatial data services (yellow)



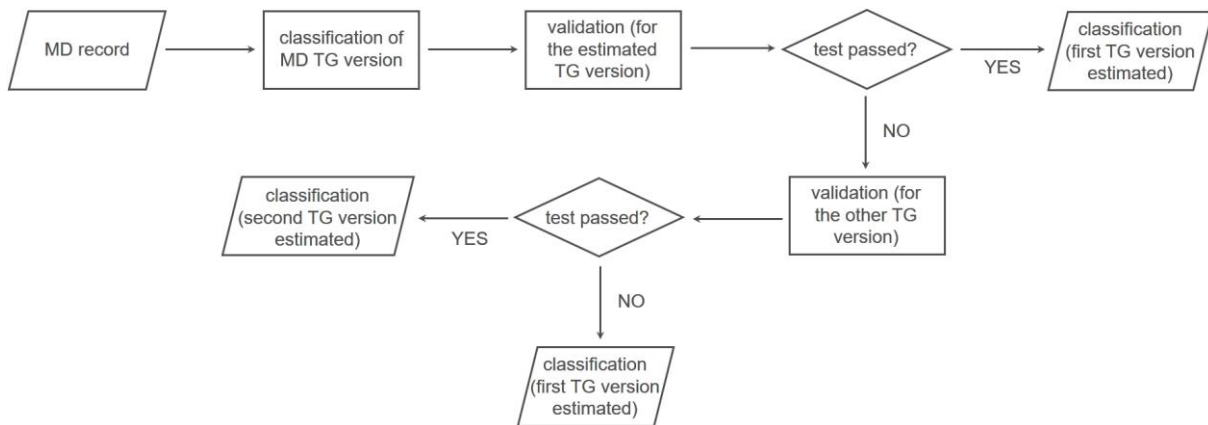
Source: JRC, 2020.

While the tests to check the conformity of metadata for spatial data sets and metadata for spatial data services are the same in TG v. 1.3 (see the red highlights in Figures 5 and 6), they substantially differ in TG v. 2.0. The latter requires different tests not only between spatial data sets and spatial data services, but also within spatial data services, in particular for network services and invocable spatial data services.

The fact that both metadata encoded according to TG v. 1.3 and TG v. 2.0 were accepted made it necessary to develop an **automated procedure to identify the correct version of metadata** and apply the related tests. While there are metadata elements which, based on their values, allow to univocally distinguish between metadata for spatial data sets and spatial data services (and, for the latter, between network services and invocable spatial data services in TG v. 2.0), there is no metadata element which directly defines the TG version adopted.

The estimation of the TG version (1.3 or 2.0) of the metadata encoding was performed using the procedure shown in Figure 7. This is based on an initial classification of the TG version according to the presence of the *<gmd:useLimitation>* element, which should only be used in metadata encoded according to TG v. 1.3 (but, in practice, can be also used as an unnecessary element in metadata encoded according to TG v. 2.0). The metadata is first validated in the INSPIRE Reference Validator against the conformance classes corresponding to the TG version derived from the initial classification. If the test is passed, this is the outcome of the whole validation and the estimated metadata version (that is also provided together with the validation outcome) is the one derived from the initial classification. Instead, if the test is not passed, the metadata is also validated in the INSPIRE Reference Validator against the conformance classes corresponding to the other TG version: if this second test is passed, this is the outcome of the whole validation and the estimated metadata version is the second one that has been tested; if this second test is not passed either, this is the outcome of the whole validation and the estimated metadata version is the one derived from the initial classification.

Figure 7. Procedure to estimate the TG version of metadata



Source: JRC, 2020.

Given that the `<gmd:useLimitation>` element can be also used in metadata encoded according to TG v. 2.0 (though unnecessary), the described procedure is only able to provide an estimation of the TG version that the data provider intended to adopt when producing the metadata. The only case of a misclassification corresponds to the case of a metadata which: in the data provider's intention, is encoded according to TG v. 2.0; includes the `<gmd:useLimitation>` element; and fails validation against the conformance classes of both TG v. 1.3 and v. 2.0. In such a case, being the first validation performed against the conformance classes of TG v. 1.3, the estimated metadata version is 1.3. However, this possible misclassification has no effect on the calculation of the indicators MDi1.1 and MDi1.2, because the outcome of a metadata validation is 'failed' only when both the validations (against the conformance classes of TG v. 1.3 and v. 2.0) fail.

The above procedure was implemented in a software tool. In addition to estimating the TG version of the metadata, the tool makes use of the REST API ⁽¹⁹⁾ of the INSPIRE Reference Validator to perform the actual validation of all metadata records harvested from the member countries discovery services. For each metadata record, the software returns the validation outcome ('passed' or 'failed') and the estimated TG version. The software also returns a number of files generated from the bulk validation of metadata: i) for each country, a zipped folder including all the test reports for the metadata that failed validation (in both HTML and JSON formats, as produced by the INSPIRE Reference Validator); ii) for each country, a spreadsheet detailing, for each metadata that failed validation, the estimated version, the total number and the full list of tests failed; and iii) a spreadsheet summarizing, for each country discovery service, the total number of failed metadata as well as the number of metadata failing each single test. These files are included in the online dashboard described in subsection 2.2.4; examples are provided in section 3. The software, which requires the Pentaho Data Integration Community Edition ⁽²⁰⁾ platform to be executed, is released ⁽²¹⁾ under the open source European Union Public License (EUPL).

2.2.4 Publication of results

As mentioned in subsections 2.2.2 and 2.2.3, the indicators calculated using the INSPIRE Geoportal and the INSPIRE Reference Validator were finally published on a dedicated **online dashboard** ⁽²²⁾ (see also Figure 1). This dashboard is aimed at providing a single point of access to all the information about 2019 monitoring and reporting, including links to the relevant documents and, for each country, the values of all the calculated indicators. The dashboard allows also to download the files about metadata validation described in subsection 2.2.3 as well as a summary file including, for each country, the values of all the calculated indicators. Some sample screenshots of the dashboard and the provided files, including a more detailed explanation, are offered in section 3.

The quantitative results of the 2019 monitoring and reporting process, i.e. the indicators calculated using the INSPIRE Geoportal and the INSPIRE Reference Validator starting from the metadata harvested from member countries discovery services, are complemented by qualitative information on the status of implementation of

⁽¹⁹⁾ <https://inspire.ec.europa.eu/validator/swagger-ui.html>

⁽²⁰⁾ <https://community.hitachivantara.com/s/article/data-integration-kettle>

⁽²¹⁾ <https://github.com/inspire-eu-validation/monitoring-bulk-validation-tool>

⁽²²⁾ <https://inspire-geoportal.ec.europa.eu/mr2019.html>

the INSPIRE Directive provided by each country in its **country fiche**. As mentioned in section 1, member countries are in fact released from drafting the full implementation report every three years and are just required to provide the relevant information online, as part of their country fiches, when changes occur in the governance of their national Spatial Data Infrastructure.

The country fiche template that member countries are required to use is shown in Table 20. The structured information provision limits the occurrence of non-structured textual information and streamlines the information to reflect a similar approach and comparable content across countries and for trend analysis. The country fiche template is modelled based on the previous template for the tri-annual INSPIRE implementation report (highlighting slow-changing descriptive information) and the yearly monitoring and reporting indicators (providing a dynamic measurement of the implementation progress). Every year the editing system for country fiche updates opens for member countries one month before the deadline, i.e. on 1st March. A dynamic visualisation of the monitoring and reporting indicators, which in the 2019 process were calculated from the INSPIRE Geoportal and the INSPIRE Reference Validator, was added to the country fiches afterwards (see the second row of Table 20). Country fiches are published in a specific section of the INSPIRE knowledge base ⁽²³⁾ in both HTML and PDF formats. An example of country fiche update showing the visualization of the 2019 monitoring and reporting indicators is provided in section 3.

Table 20. Yearly published information on member countries INSPIRE implementation status, including the country fiche template and the visualization of the monitoring and reporting indicators

<p>State of play</p> <p>Coordination</p> <ul style="list-style-type: none"> — National Contact Point — Coordination Strategy (image if available) — Progress <p>Functioning and coordination of the infrastructure</p> <ul style="list-style-type: none"> — Progress <p>Usage of the infrastructure for spatial information</p> <ul style="list-style-type: none"> — Progress — Cross-border <p>Data Sharing Arrangements</p> <ul style="list-style-type: none"> — Progress <p>Costs and Benefits</p> <ul style="list-style-type: none"> — Assessment 	<p>Based on member countries updates</p>
<p>Visualisation of indicators</p>	<p>Based on the INSPIRE Geoportal and the INSPIRE Reference Validator</p>

⁽²³⁾ <https://inspire.ec.europa.eu/INSPIRE-in-your-Country>

3 2019 Monitoring and reporting: aggregated results

Overall, the harvesting process for 2019 monitoring and reporting involved **35 discovery services** belonging to 32 countries, given that each country has one discovery service except for BE which has four. **The total number of harvested metadata was equal to 261060**. As mentioned in subsection 2.2.4, all the results of 2019 monitoring and reporting are accessible from an online dashboard ⁽²⁴⁾. The landing page provides summary information on the metadata harvested for each country (i.e. number of metadata for spatial data sets, data set series and spatial data services) as well as the links to the relevant documentation on 2019 monitoring and reporting: Commission Decision (EU) 2019/1372, a guidance document ⁽²⁵⁾ and a presentation ⁽²⁶⁾ on the calculation of indicators (see Figure 8).

When clicking on the blue rectangle corresponding to a member country, a new web page opens, which provides the detailed results for that specific country. An example of such page is provided in Figure 9. At the top of the page, general information about the discovery service is provided, i.e. URL of the discovery service, ID of the endpoint, and date of the harvesting; the remaining part of the page includes the results retrieved from that specific endpoint. In the case of BE, results for the different endpoints can be accessed by simply switching from one tab to another at the top of the page.

Below the general information about the discovery service, the web page shows some overview statistics of the harvested metadata, i.e. the number of metadata for spatial data sets, spatial data set series and spatial data services, as well as the number of metadata estimated to be encoded according to TG v. 1.3 and 2.0 (see subsection 2.2.3). This is followed by a section including the results of the metadata validation performed using the INSPIRE Reference Validator (see Figure 9), i.e.: the number of conformant and non-conformant metadata for both spatial data sets (including those for data sets and data set series) and spatial data services; and the links to download: i) the zipped folders including all the test reports for the metadata that failed validation (separated for spatial data sets and spatial data services); ii) the spreadsheet detailing, for each metadata, the estimated version, the total number and the full list of tests which failed; and iii) the spreadsheet summarizing, for all member countries together, the total number of failed metadata as well as the number of metadata failing each single test (see subsection 2.2.3). Examples of these two spreadsheets are provided in Figures 10 and 11.

Below this section, the web page displays the main section about the calculated indicators for 2019 monitoring and reporting. These are again divided according to the category they belong to: availability of spatial data sets and services (DSi1.1, DSi1.2, DSi1.3, DSi1.4, DSi1.5), conformity of spatial data sets (DSi2, DSi2.1, DSi2.2, DSi2.3), accessibility of spatial data sets (NSi2, NSi2.1, NSi2.2), conformity of network services (NSi4, NSi4.1, NSi4.2, NSi4.3, NSi4.4) and conformity of metadata (MDi1.1, MDi1.2) (see Figure 9). Additional notes on the calculation of MDi1.1 and MDi1.2, explaining which conformance classes are tested in the INSPIRE Reference Validator according to the type of metadata (see subsection 2.2.3 and Figures 5 and 6), are included below the indicator section. Finally, at the very bottom of the web page a green button allows to download another spreadsheet including the calculated values of the 19 indicators for the specific endpoint considered.

Finally, Figure 12 shows an example of inclusion of dynamic visualizations for the 2019 monitoring and reporting indicators (again divided according to the category they belong to) in the country fiches (see subsection 2.2.4) available from the INSPIRE knowledge base ⁽²⁷⁾.

⁽²⁴⁾ <https://inspire-geoportal.ec.europa.eu/mr2019.html>

⁽²⁵⁾ <https://europa.eu/ITu47HB>

⁽²⁶⁾ <https://europa.eu/Hf88YR>

⁽²⁷⁾ <https://inspire.ec.europa.eu/INSPIRE-in-your-Country>

Figure 8. Landing page of the 2019 monitoring and reporting dashboard

INSPIRE Monitoring 2019

MS resources processing status - completed on 15.04.2020



Documentation:

[Commission Implementing Decision \(EU\) 2019/1372 of 19 August 2019 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards monitoring and reporting](#)

[Guidance document for the calculation of indicators \(DOC 6\)](#)

[Indicators calculation \(PRES-1.1\)](#)

Source: JRC, 2020.

Figure 9. Example of page showing the detailed 2019 monitoring and reporting results (including the calculated indicators) for a single member country

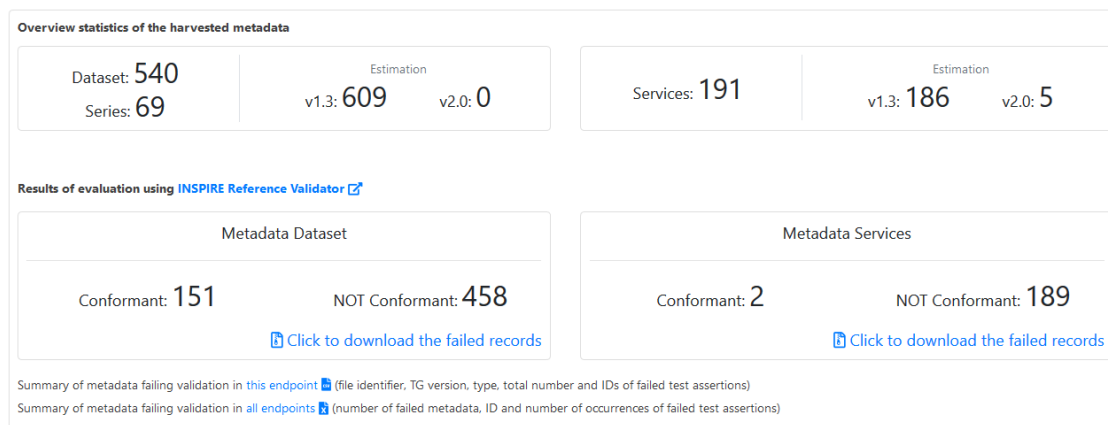
Indicators in support of Commission Decision (EU) 2019/1372 implementing Directive 2007/2/EC (INSPIRE) as regards to monitoring and reporting

Finland +

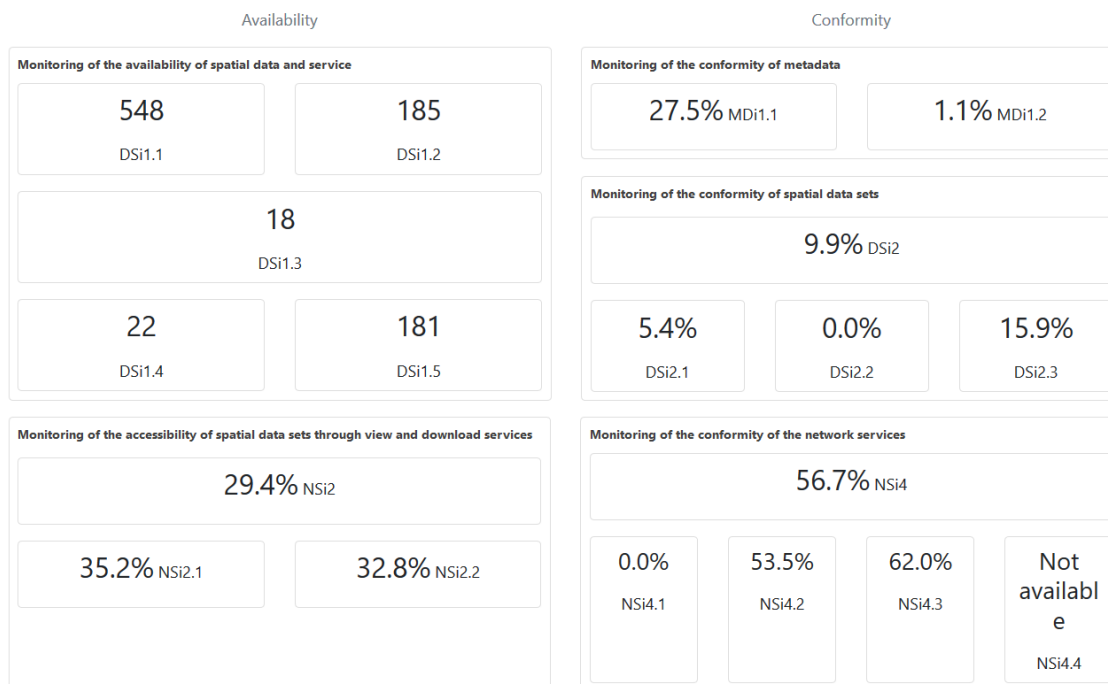
MD Catalogue URL: <https://www.paikkatietohakemisto.fi/geonetwork/srv/fin/csw>

Endpoint ID: INSPIRE-f670705f-f4e9-11e6-81e4-52540023a883

The date of harvest metadata: 2019-12-16



Monitoring Indicators 2019



► Notes on MDi1.1 and MDi1.2 evaluation

Documentation:

Commission Implementing Decision (EU) 2019/1372 of 19 August 2019 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards monitoring and reporting

Guidance document for the calculation of indicators (DOC 6)

Indicators calculation (PRES-1.1)

[Download the calculated 2019 indicators](#)

Source: JRC, 2020.

Figure 12. Example of inclusion of dynamic visualizations of the 2019 monitoring and reporting indicators in the update of country fiches

INSPIRE monitoring 2019 Austria

Indicators in support of [Commission Decision \(EU\) 2019/1372](#) implementing Directive 2007/2/EC (INSPIRE) as regards to monitoring and reporting



Source: JRC, 2020

3.1 Indicator results

Table 22 provides a full overview of the quantitative values for the 19 indicators of 2019 monitoring and reporting for all member countries. These values are automatically computed from the INSPIRE Geoportal and the INSPIRE Reference Validator according to the calculation methods described, for each indicator, in subsections 2.1.1 to 2.1.5. It should be noted that the 5 indicators related to the availability of spatial data sets and spatial data services (DSi1.1, DSi1.2, DSi1.3, DSi1.4 and DSi1.5) are expressed in absolute terms and therefore do not allow for an immediate country-by-country comparison. The values of such indicators (number of spatial data sets and spatial data services, number of spatial data sets used for reporting under the environmental legislation, number of spatial data sets with a national and regional scope) may indeed depend on several characteristics of each country (geographical extent, administrative structure, organisational approach used for data provision, etc.). The values of these indicators, and in particular of DSi1.1, DSi1.2 and DSi1.4) are significantly higher – in some cases even two orders of magnitude – for 5 countries: DE, FR, IT, PL and UK (see Table 22). Instead, the 14 remaining indicators are expressed in relative terms, i.e. as a percentage (see Table 22) and therefore they can be used for a direct country-by-country comparison. Also, sometimes indicators are assigned a value 'NA' (see Table 22). This happens when the hypothesis needed for the calculation of the indicator is not satisfied and thus it is not possible to calculate its value; for example, indicator NSi4.4 gets a value 'NA' when the corresponding country has no transformation services.

According again to the 5 categories established in the Commission Decision (EU) 2019/1372, the following subsections (from 3.1.1 to 3.1.5) provide detailed results for each indicator, including summary statistics and graphics.

3.1.1 Availability of spatial data and services

As mentioned at the beginning of section 3, the overall number of metadata records (either for spatial data sets or spatial data services) harvested from member countries discovery services using the INSPIRE Geoportal equals over 260 thousand. These records include about 160 thousand metadata for data sets (including data set series) and about 100 thousand metadata for spatial data services. Table 21 provides summary statistics (mean, median, standard deviation, minimum and maximum) for the indicators DSi1.1, DSi1.2, DSi1.3, DSi1.4 and DSi1.5.

Table 21. Summary statistics for the indicators DSi1.1, DSi1.2, DSi1.3, DSi1.4 and DSi1.5

	Mean	Median	St. deviation	Min	Max
DSi1.1	4969	169	11690	42	42066
DSi1.2	3079	159	10952	3	52629
DSi1.3	52	45	43	0	164
DSi1.4	384	0	1937	0	10975
DSi1.5	84	73	83	0	333

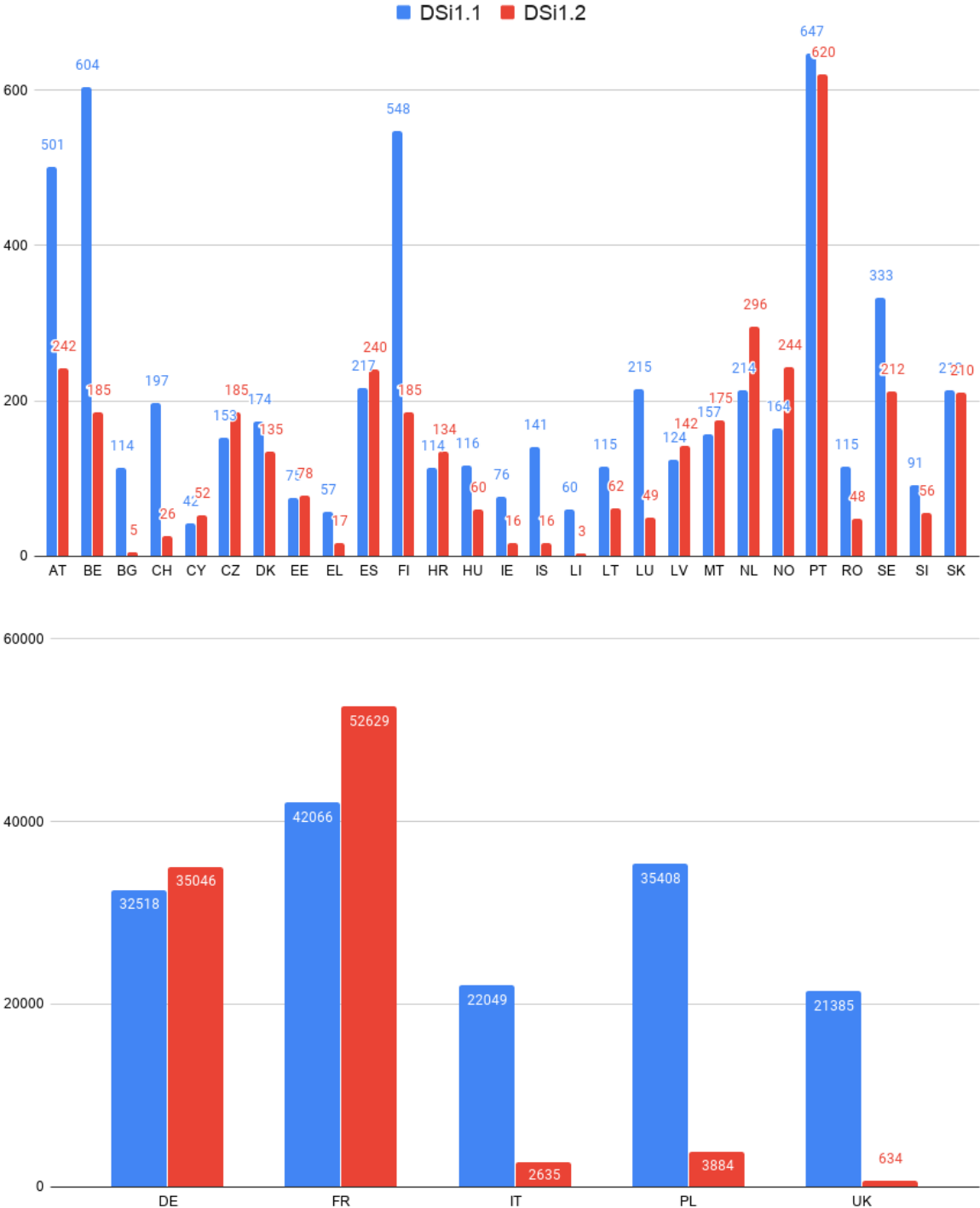
In Figure 13 the values of indicators DSi1.1 and DSi1.2 are plotted together for all member countries (ordered alphabetically); the 5 countries with significantly higher values of such indicators – almost all higher than 20 thousand – are plotted separately for improved visualisation. Figure 13 shows that the **availability of spatial data sets and spatial data services varies widely across countries** (see Table 22 for the full set of values). Usually the number of available spatial data sets is higher than the number of available spatial data services; exceptions are represented by CY, CZ, EE, ES, HR, LV, MT, NL, NO, DE and FR. While in some countries such as EE, PT and SK the number of available services almost equals to that of data sets, most countries show significant variations and for some of them (BG, IS, LI, IT, PL and UK) the number of spatial data services is less than or close to the 10% of the number of spatial data sets.

Table 22. Quantitative values for the indicators of 2019 monitoring and reporting for all member countries

	DSi1.1	DSi1.2	DSi1.3	DSi1.4	DSi1.5	MDi1.1	MDi1.2	DSi2	DSi2.1	DSi2.2	DSi2.3	NSi2	NSi2.1	NSi2.2	NSi4	NSi4.1	NSi4.2	NSi4.3	NSi4.4
AT	501	242	93	270	225	58.9%	84.3%	28.1%	72.8%	2.9%	18%	70.5%	83.4%	81.8%	90.1%	85.7%	90.9%	89.1%	NA
BE	604	185	164	244	90	64.7%	43.7%	28.3%	87.1%	18.3%	23.2%	50%	82.6%	51.8%	48.6%	50%	52.9%	44.7%	NA
BG	114	5	114	35	79	0%	0%	96.5%	93.6%	NA	97.2%	66.7%	66.7%	71.1%	100%	100%	NA	NA	NA
CH	197	26	0	0	1	2%	0%	2%	7.1%	0%	0%	1%	2%	1%	0%	0%	0%	0%	NA
CY	42	52	5	0	0	2.4%	3.9%	2.4%	0%	25%	0%	0%	0%	0%	0.1%	NA	0%	0%	NA
CZ	153	185	40	55	96	20.3%	58.9%	34%	91.3%	33.3%	22.8%	24.8%	48.4%	34%	84.1%	100%	86.3%	81.2%	100%
DE	32518	35046	108	10975	156	65.4%	91.7%	56%	40%	33%	57.1%	34.7%	39.5%	37.9%	82.4%	100%	84.6%	79.1%	NA
DK	174	135	50	0	106	37.9%	65.2%	37.9%	90.5%	18.8%	31.1%	27%	35.1%	30.5%	85%	NA	80.7%	88.6%	NA
EE	75	78	21	0	74	41.3%	19.2%	89.3%	90.5%	87.5%	89.5%	17.3%	32%	18.7%	98.6%	0%	100%	100%	NA
EL	57	17	54	0	33	100%	100%	0%	0%	NA	0%	100%	100%	100%	5.9%	100%	0%	0%	NA
ES	217	240	84	14	29	25.3%	32.1%	99.5%	100%	95%	100%	7.8%	18%	8.8%	97.9%	100%	97.9%	97.9%	NA
FI	548	185	18	22	181	27.5%	1.1%	9.9%	5.4%	0%	15.9%	29.4%	35.2%	32.8%	56.7%	0%	53.5%	62%	NA
FR	42066	52629	123	10	44	0%	4.3%	8.7%	7%	9.7%	8.7%	0.5%	31.7%	2.9%	1%	4.9%	3%	NA	0%
HR	114	134	15	0	91	36.8%	31.3%	88.6%	91.4%	100%	85.3%	11.4%	14%	26.3%	91.7%	100%	90%	94%	NA
HU	116	60	19	0	7	15.5%	38.3%	37.9%	32.4%	32.6%	36%	7.8%	10.3%	9.5%	13.3%	60%	7.1%	11.1%	NA
IE	76	16	39	0	0	84.2%	6.2%	90.8%	86.7%	85.7%	92.6%	0%	0%	0%	6.3%	100%	0%	0%	NA
IS	141	16	2	0	0	0.7%	0%	6.4%	4.2%	17.1%	22.2%	0%	0%	16.3%	0%	NA	0%	0%	0%
IT	22049	2635	43	637	7	64.4%	1.9%	57.7%	73.6%	16.6%	44.5%	0.4%	1.8%	1%	1.1%	0%	1.6%	0.1%	0%
LI	60	3	0	0	47	0%	0%	5%	0%	5.6%	8.7%	0%	0%	0%	0%	NA	0%	0%	NA
LT	115	62	75	0	15	64.3%	80.6%	90.4%	93.8%	100%	90.3%	15.7%	15.7%	77.4%	100%	NA	100%	100%	NA
LU	215	49	76	0	215	99.5%	93.9%	69.8%	94.9%	96.6%	57.8%	56.7%	58.6%	97.7%	81.6%	100%	62.5%	100%	NA
LV	124	142	29	0	0	38.7%	73.9%	46.8%	48.7%	50%	56.8%	16.9%	33.9%	17.7%	7.7%	NA	9.5%	5.2%	NA
MT	157	175	54	0	155	45.8%	68%	75.2%	93.8%	100%	70.3%	3.2%	42%	9.6%	0%	0%	0%	0%	NA
NL	214	296	70	0	200	42.9%	77.3%	41.6%	63.6%	52.2%	31.9%	57.5%	62.1%	69.2%	89.8%	0%	90.1%	90.1%	NA
NO	164	244	14	7	150	0%	0%	37.2%	54.5%	43.3%	34.6%	9.8%	12.8%	40.9%	12%	100%	11.8%	11.4%	NA
PL	35408	3884	47	0	128	51.2%	50.6%	76.4%	80.8%	44.2%	75.6%	0.9%	25%	1.4%	47.8%	35.7%	32%	94.6%	NA
PT	647	620	134	0	1	57.6%	32.1%	33.5%	60.4%	19.4%	31.8%	29.7%	40.8%	36.8%	52.4%	0%	53.1%	51.4%	NA
RO	115	48	30	15	100	3.4%	77.1%	30.4%	69.6%	23.5%	20.5%	15.7%	19.1%	20%	66.7%	50%	76.2%	57.9%	NA
SE	333	212	77	0	333	55.2%	43.4%	95.8%	97.3%	77.4%	99.1%	31.5%	54.4%	33.9%	93.8%	0%	96.5%	91.5%	NA
SI	91	56	9	0	62	26.3%	23.2%	62.6%	75%	61.5%	62.3%	5.5%	11%	14.3%	26.8%	0%	4%	46.7%	NA
SK	213	210	53	0	72	12.6%	38.1%	8%	3.3%	8.3%	7.9%	8.5%	15.5%	10.3%	40.9%	14.3%	39.3%	46.2%	0%
UK	21385	634	0	4	0	0.1%	12.7%	3.1%	19.5%	0.5%	4.7%	0.2%	1.1%	0.7%	0%	0%	0%	0.1%	NA

Table 21 confirms the variability of the values of DSi1.1 and DSi1.2; in particular, the notable difference between the mean and the median is explained by the presence of the 5 countries with significantly higher values of spatial data sets and spatial data services.

Figure 13. Values of indicators DSi1.1 and DSi1.2 for all member countries; countries with significantly higher values are separately plotted below

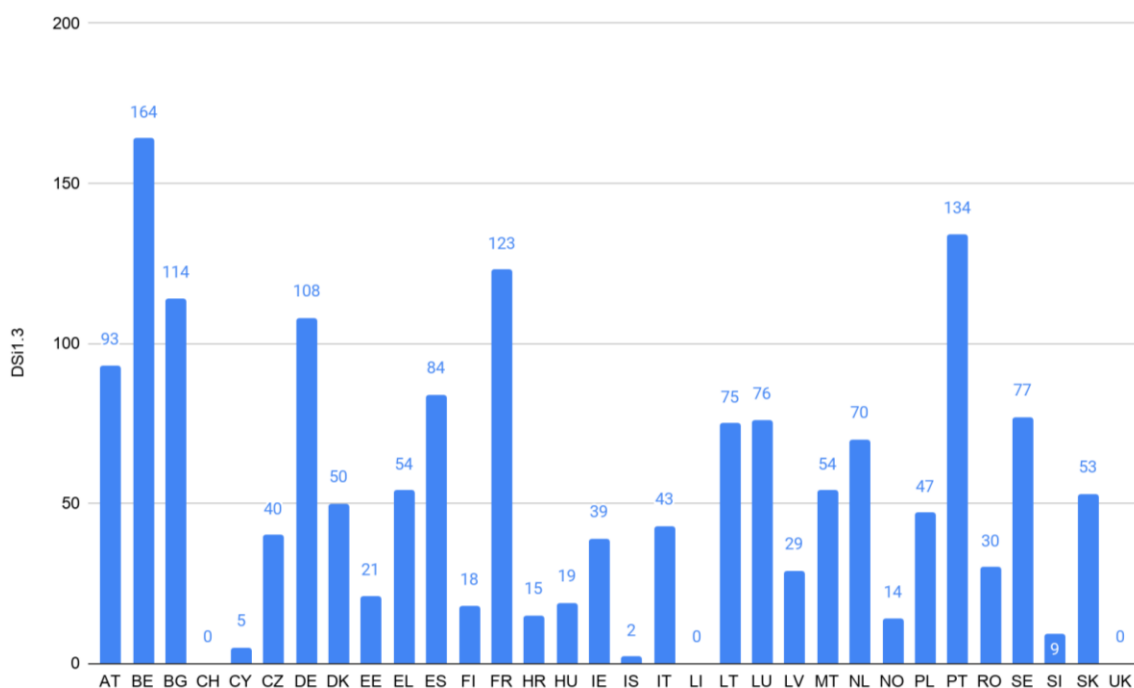


Source: JRC, 2020.

Figure 14 shows the values of indicator DSi1.3 for all member countries (ordered alphabetically). This indicator corresponds to the number of spatial data sets used for reporting under the environmental legislation, which are also referred to as priority data sets. The distribution of values is again heterogeneous across countries: most of them offer some tens of priority data sets (the mean, median and standard deviation are all around

50, see Table 21), while few of them provide more than one hundred (BE, BG, DE, FR and PT) or less than 10 (CY, IS and SI); CH, LI and UK do not provide any such data set.

Figure 14. Values of indicator DSi1.3 for all member countries



Source: JRC, 2020.

Finally, Figure 15 plots together the values of indicators DSi1.4 and DSi1.5 for all member countries (ordered alphabetically); the 5 countries with significantly higher values of such indicators are again plotted separately for improved visualisation. In addition to DSi1.4 and DSi1.5, which correspond to the number of spatial data sets with a regional and national scope, respectively, Figure 15 also includes the number of spatial data sets with a local scope. The latter represents the highest share for most of the countries, with some of them (CH, CY, HU, IE, IS, LT, LV, PT, FR, IT, PL and UK) which are only, or almost only, sharing local data sets. The total number of regional data sets is over 12 thousand but almost 90% of these are shared by DE; AT and BE have half of their data sets tagged as regional, while all the other countries have few or no regional data sets (the median is equal to 0, see Table 21). National data sets (about 2700 in total) are instead more common across member countries, although there are still countries which are not sharing national data sets (e.g. CY, IE, HS and UK) and two countries (LU and SE) which are instead only sharing national data sets.

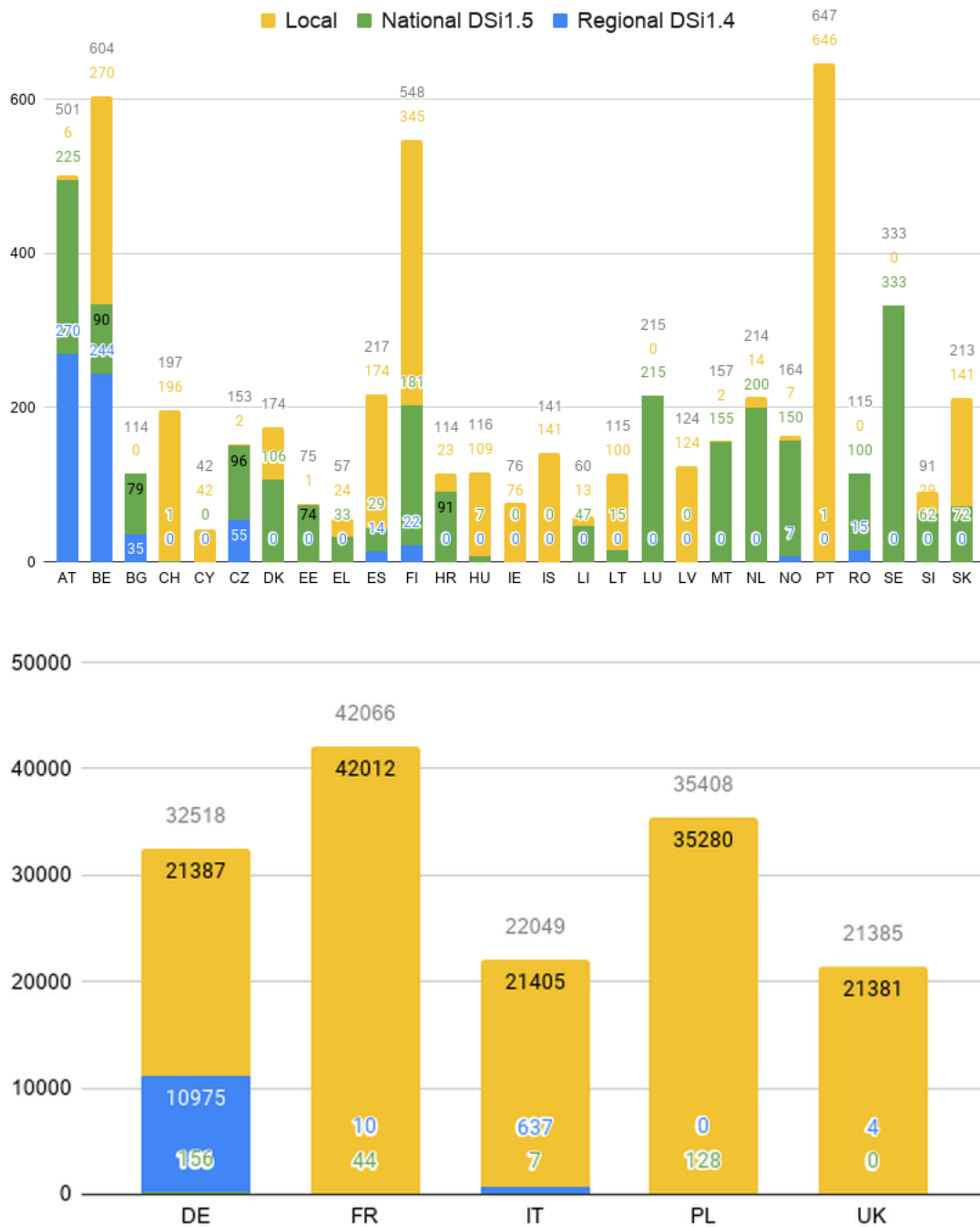
3.1.2 Conformity of metadata with Regulation (EC) No 1205/2008

Indicators MDi1.1 and MDi1.2 correspond, respectively, to the fractions of metadata for spatial data sets and metadata for spatial data services which are conformant with Regulation (EC) No 1205/2008. Their values are calculated using the INSPIRE Reference Validator. Table 23 provides summary statistics (mean, median, standard deviation, minimum and maximum) for the indicators MDi1.1 and MDi1.2.

Table 23. Summary statistics for the indicators MDi1.1 and MDi1.2

	Mean	Median	St. deviation	Min	Max
MDi1.1	36%	37%	30%	0%	100%
MDi1.2	39%	35%	34%	0%	100%

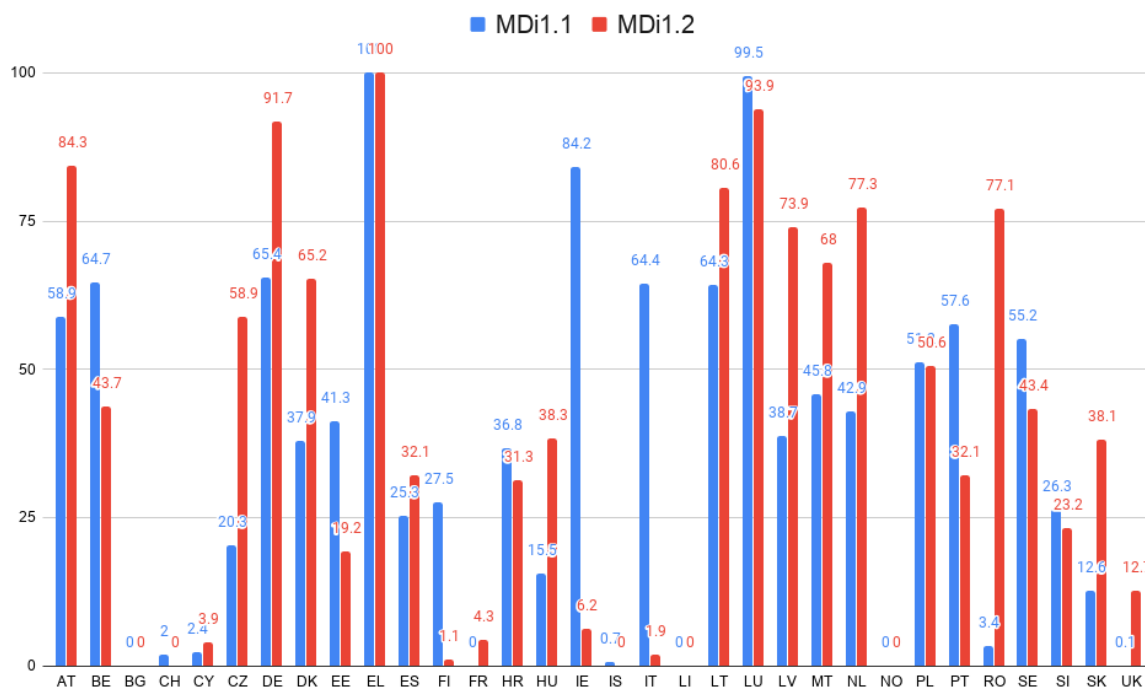
Figure 15. Values of indicators DSi1.4, DSi1.5 and number of local data sets for all member countries; countries with significantly higher values are separately plotted below



Source: JRC, 2020.

Table 23 is complemented by Figure 16, which plots together the values of indicators MDi1.1 and MDi1.2 for all member countries (ordered alphabetically). Once again, the values of these indicators are very heterogeneous across countries, spanning the full domain of values between 0% and 100% (see Table 22 for the full set of values); **the mean and median values are low**, i.e. between 36% and 39% for both MDi1.1 and MDi1.2, but the very high standard deviation (equal or higher than 30% for both indicators) confirms the significant variability of the values. Looking at the country-specific situation, it can be observed that in general the performance is different for the two indicators, with values of MDi1.2 in general higher than those of MDi1.1. Some countries are scoring very low in both indicators (BG, CH, CY, FR, IS, LI and NO), some are scoring very low only in one indicator (RO and UK for MDi1.1; FI, IE and IT for MDi1.2), some are scoring very high only in one indicator (IE for MDi1.1; AT, DE, LT, NL and RO for MDi1.2), while some are scoring very high in both indicators (LU and EL, the latter with values of 100% for both MDi1.1 and MDi1.2).

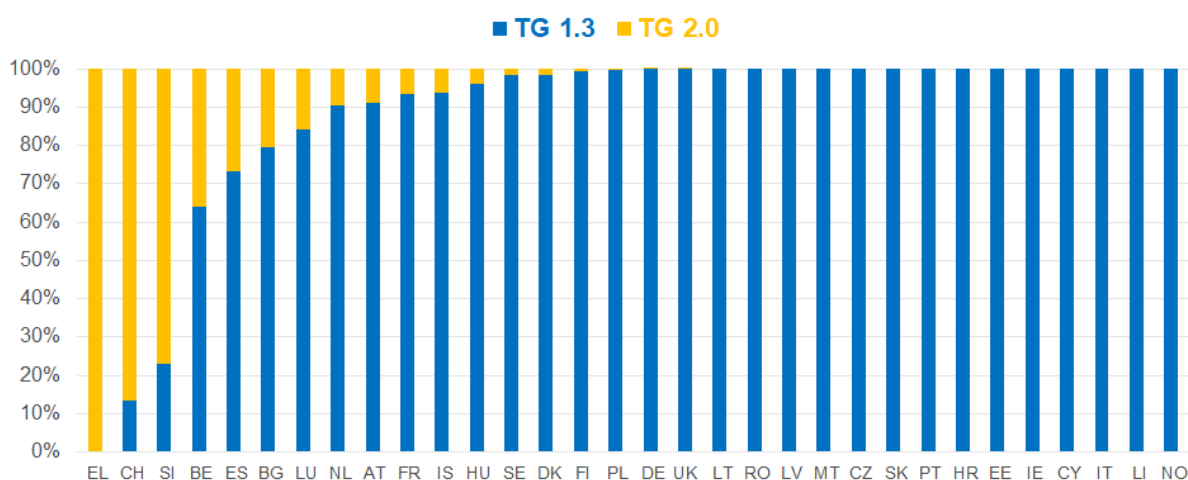
Figure 15. Values of indicators MDi1.1 and MDi1.2 for all member countries



Source: JRC, 2020.

As detailed in subsection 2.2.3, for 2019 monitoring and reporting both metadata encoded according to TG v. 1.3 and TG v. 2.0 were accepted and a specific procedure to estimate the TG version was applied. Based on the results of this procedure, Figure 16 shows, for all member countries, the estimated proportions of metadata encoded according to TG v. 1.3 and TG v. 2.0. Countries are ordered in descending order according to the number of metadata encoded according to TG v. 2.0. Table 24 complements Figure 16 by providing global statistics on the share of the TG version of metadata. Overall, despite the transition from TG v. 1.3 to TG v. 2.0 ended in December 2019, **only 3% of the total number of metadata are encoded according to TG v. 2.0**; this percentage rises to 4% for metadata for spatial data sets and drops to 1% for metadata for spatial data series. EL, CH and SI are the countries producing most metadata encoded according to TG v. 2.0 (see Figure 16); remaining countries have values well below 40%, with 20 of them scoring values equal or close to 0%. For EL, all metadata are encoded according to TG v. 2.0 and all are conformant.

Figure 16. Proportions of metadata encoded according to TG v. 1.3 and TG v. 2.0 for all member countries



Source: JRC, 2020.

Table 24. Global statistics on the proportions of metadata encoded according to TG v. 1.3 and TG v. 2.0

	Metadata for spatial data sets	Metadata for spatial data services	All metadata
TG v. 1.3	96%	99%	97%
TG v. 2.0	4%	1%	3%

3.1.3 Conformity of spatial data sets with Commission Regulation (EU) No 1089/2010 on interoperability

Indicator DSi2 corresponds to the overall percentage of spatial data sets shared by member countries which are conformant with Commission Regulation (EU) No 1089/2010 as regards interoperability of spatial data sets. Indicators DSi2.1, DSi2.2 and DSi2.3 have the very same meaning of DSi2, but they reflect the conformity of spatial data sets corresponding to the themes listed in Annex I, II and III of the INSPIRE Directive, respectively. The values of such indicators are calculated using the INSPIRE Geoportal; the information about conformity is included in the metadata of spatial data sets and is self-declared by member countries. Table 25 provides summary statistics (mean, median, standard deviation, minimum and maximum) for the indicators DSi2, DSi2.1, DSi2.2 and DSi2.3.

Table 25. Summary statistics for the indicators DSi2, DSi2.1, DSi2.2 and DSi2.3.

	Mean	Median	St. deviation	Min	Max
DSi2	45%	38%	34%	0%	100%
DSi2.1	57%	71%	37%	0%	100%
DSi2.2	42%	33%	35%	0%	100%
DSi2.3	44%	33%	34%	0%	100%

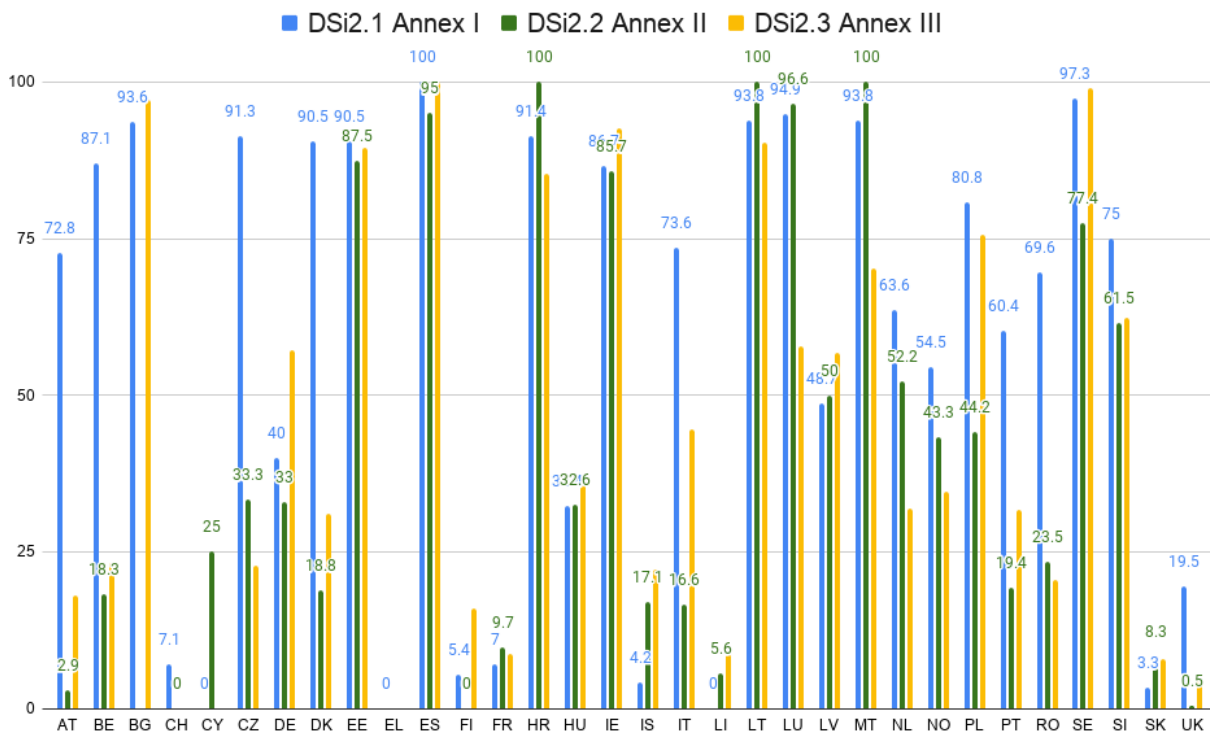
Table 25 is complemented by Figure 17, where the values of indicators DSi2.1, DSi2.2 and DSi2.3 are plotted together for all member countries (ordered alphabetically). Once again the performance of member countries is very heterogeneous, with values between 0% and 100% (see Table 22 for the full set of values), mean and median values between 33% and 71% and high standard deviations (around 35% for all the three indicators). It should be noted that, according to the INSPIRE roadmap ⁽²⁸⁾, data sets corresponding to the themes listed in Annex I shall be conformant since 2017; the deadline for conformant data sets corresponding to the themes listed in Annex II and III is instead in 2020. Therefore, despite the mean and median values of DSi2.1 are higher than those of DSi2.2 and DSi2.3, **these are still low in absolute terms** as ideally in 2019 they should already be equal to 100%. Figure 17 further confirms the heterogeneity across member countries. For some countries (EE, ES, IE, LT and SE) the values of DSi2.1, DSi2.2 and DSi2.3 (and, as a consequence, of DSi2) are all close or equal to 100%, while for some others (CH, CY, EL, FI, IS, LI, SK and UK) they are all close or equal to 0%; the remaining countries show instead performances in between. In addition, only few countries score similar values for the three indicators; the majority of them show significant differences with, in general, higher values for DSi2.1 (due to the reasons explained above), followed by DSi2.3 and DSi2.2.

It is important to remind that the conformity of spatial data sets is self-declared by member countries, i.e. it is not automatically derived through the use of the INSPIRE Reference Validator. However, as described in subsection 2.1.3, the European Commission might use the Reference Validator to assess the actual conformity of a sample of the countries resources declared as conformant.

⁽²⁸⁾ <https://inspire.ec.europa.eu/inspire-roadmap>

Indicators DSi2, DSi2.1, DSi2.2 and DSi2.3 are expressed as percentages and therefore they do not reveal the actual numbers of conformant spatial data sets corresponding to the themes listed in Annex I, II and III. These can be derived by intersecting the information provided by Figure 17 with that of Figure 18, which shows the total number of data sets corresponding to the INSPIRE themes listed in Annex I, II and III for all member countries (ordered alphabetically). Since the number of INSPIRE themes listed in Annex III (21) is higher than the number of themes listed in Annex II (4) and Annex I (9), it is not surprising that most of the data sets (almost 75% of the approximately 160 thousand data sets which are overall available) correspond to themes listed in Annex III, followed by Annex II (17%) and Annex I (8%).

Figure 17. Values of indicators DSi2.1, DSi2.2 and DSi2.3 for all member countries



Source: JRC, 2020.

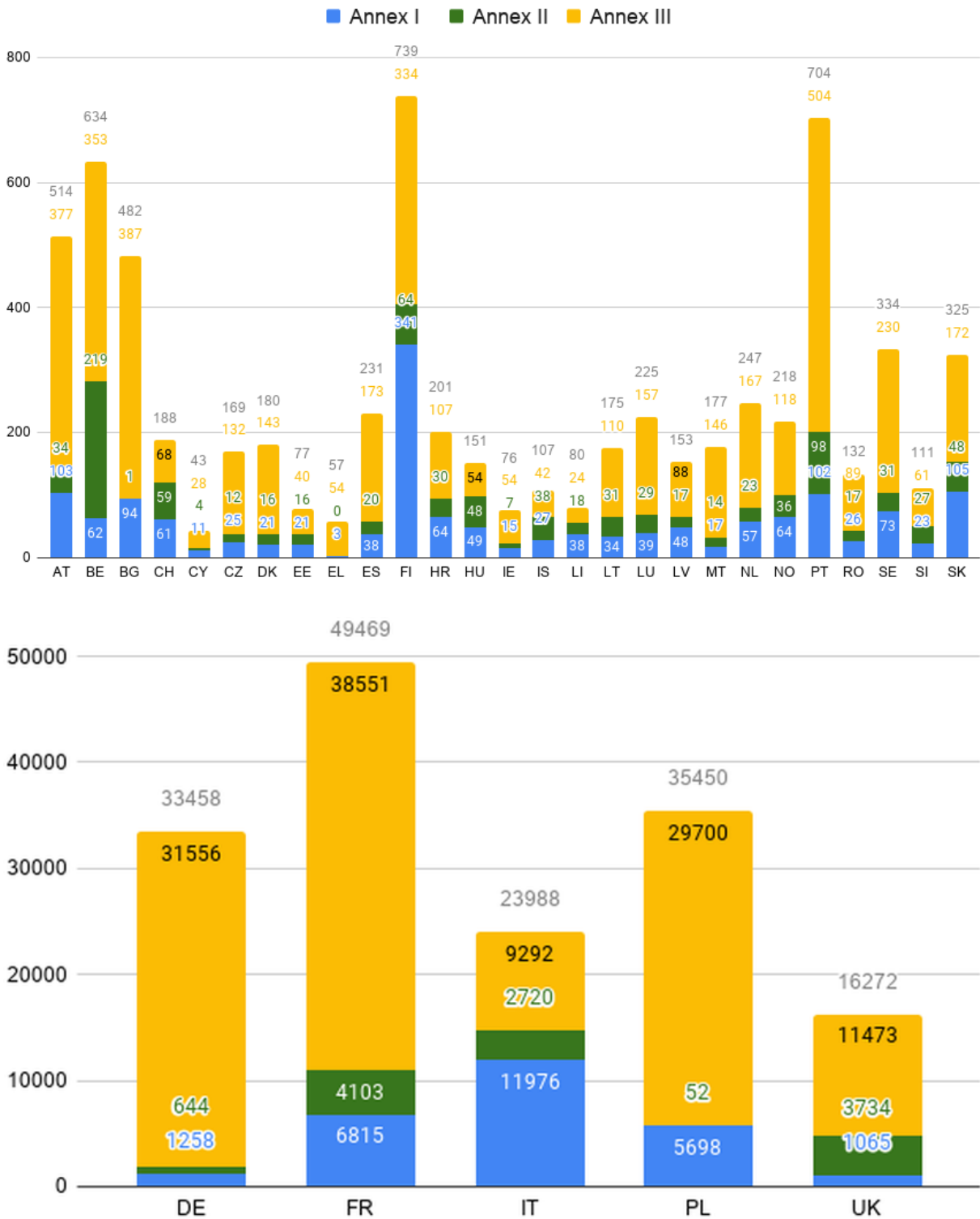
3.1.4 Accessibility of spatial data sets through view and download services

Indicators NSi2, NSi2.1 and NSi2.2 measure the actual accessibility of INSPIRE spatial data sets from a user perspective. NSi2.1 and NSi2.2 correspond to the percentage of spatial data sets which are accessible through view services and download services, respectively. Instead, NSi2 corresponds to the percentage of spatial data sets accessible through both view and download services. The values of these indicators are calculated using the INSPIRE Geportal, which, based on the metadata records harvested from each national catalogue, aims to establish linkages between metadata of spatial data sets and those of spatial data services (in particular view and download services): if linkages are found, the data set is classified as viewable and/or downloadable. Table 26 provides summary statistics (mean, median, standard deviation, minimum and maximum) for the indicators NSi2, NSi2.1 and NSi2.2.

Table 26. Summary statistics for the indicators NSi2, NSi2.1 and NSi2.2

	Mean	Median	St. deviation	Min	Max
NSi2	22%	14%	25%	0%	100%
NSi2.1	31%	28%	27%	0%	100%
NSi2.2	30%	19%	30%	0%	100%

Figure 18. Number of spatial data sets corresponding to the themes listed in Annex I, II and III for all member countries; countries with significantly higher values are separately plotted below

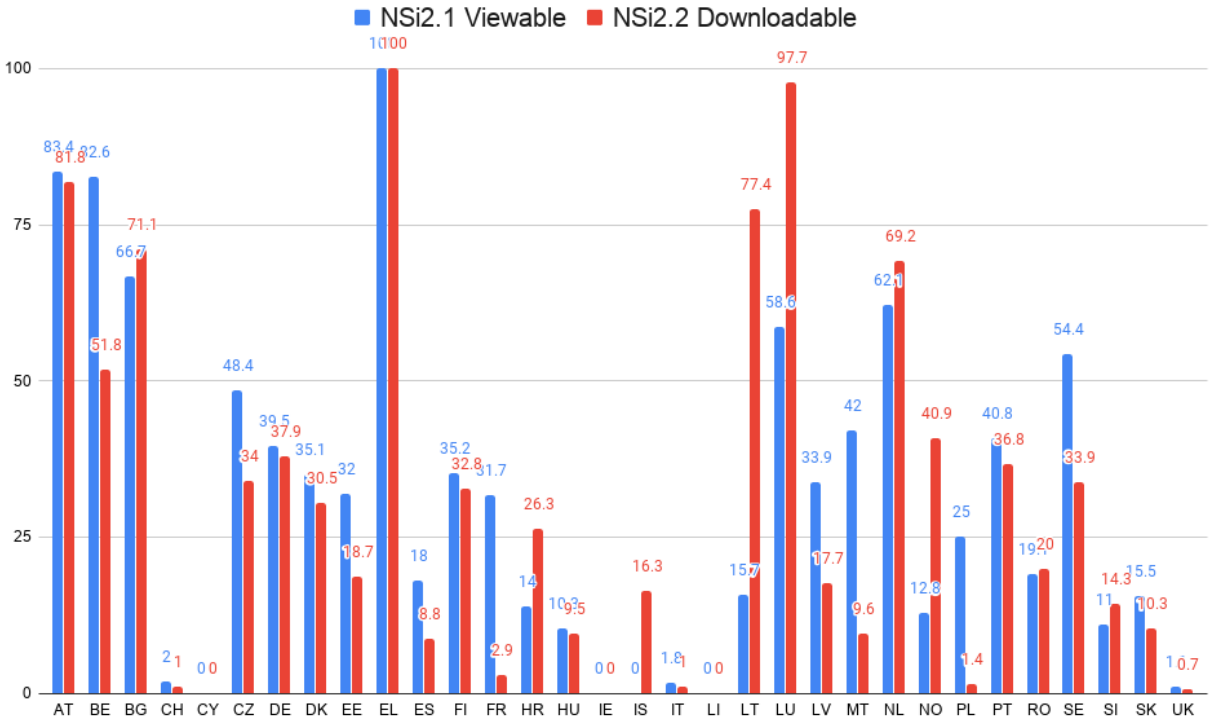


Source: JRC, 2020.

Table 26 shows that the mean and median values of the indicators NSi2, NSi2.1 and NSi2.2 are overall low, i.e. less than one third. **This gives a clear idea of how many data sets** (out of about 160 thousand in total) **are not yet accessible**. Also, the mean and median values of NSi2 (the latter only equal to 14%) are lower than those of NSi2.1 and NSi2.2, which proves that a significant fraction of the data sets are either only viewable or only downloadable. Figure 19 complements Table 26 by plotting together the values of indicators NSi2.1 and NSi2.2 for all member countries (ordered alphabetically). Once again, the values of the indicators

NSi2, NSi2.1 and NSi2.2 span the full range of values from 0% to 100% (see Table 22 for the full set of values). Some countries (CH, CY, IE, IT, LI and UK) provide zero, or almost zero, data sets through both view and download services, while others (ES, FR, HU, IS, MT and PL) score values of at least one of the two indicators lower than 10%. On the opposite, EL is the only country scoring 100% for both NSi2.1 and NSi2.2 and only few other countries (AT, BE, LT and LU) score values of at least one of the two indicators higher than 75%.

Figure 19. Values of indicators NSi2.1 and NSi2.2 for all member countries



Source: JRC, 2020.

3.1.5 Conformity of network services with Regulation (EC) No 976/2009

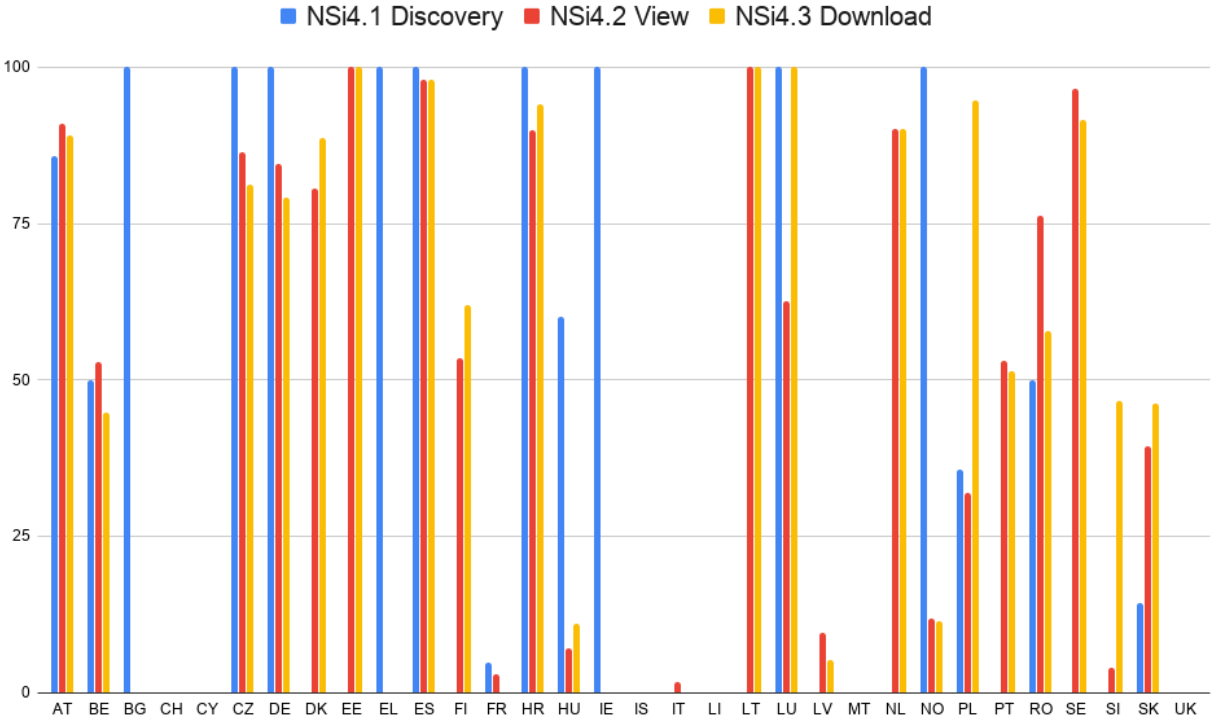
The last set of indicators (NSi4, NSi4.1, NSi4.2, NSi4.3 and NSi4.4) measure the conformity of INSPIRE network services. While indicator NSi4 measures the overall percentage of conformant network services, indicators NSi4.1, NSi4.2, NSi4.3 and NSi4.4 correspond to the conformant portions of each type of network services, i.e. discovery services, view services, download services and transformation services, respectively. The values of these indicators are calculated based on the self-declaration of conformity included in the network service metadata harvested from the INSPIRE Geoport. Table 27 provides summary statistics (mean, median, standard deviation, minimum and maximum) for the indicators NSi4, NSi4.1, NSi4.2 and NSi4.3 and NSi4.4.

Table 27. Summary statistics for the indicators NSi4, NSi4.1, NSi4.2, NSi4.3 and NSi4.4

	Mean	Median	St. deviation	Min	Max
NSi4	46%	48%	40%	0%	100%
NSi4.1	46%	43%	46%	0%	100%
NSi4.2	41%	36%	40%	0%	100%
NSi4.3	48%	49%	41%	0%	100%
NSi4.4	20%	0%	40%	0%	100%

With the exception of NSi4.4 (see below), Table 27 shows that the summary statistics for all the indicators have similar values. The mean number of conformant discovery, view and download services is between 40% and 50%, with standard deviations also included in the range 40%-50% which demonstrate, once again, the high heterogeneity of values across member countries (see Table 22 for the full set of values). The statistical values for NSi4.4 are instead not significant since they are biased by the extremely low availability of transformation services. As shown in Table 22, only 5 countries (CZ, FR, IS, IT and SK) have at least one transformation service – which is the reason why the indicator has a value ‘NA’ for the remaining countries – and the only such service that is conformant is provided by CZ. Figure 20 shows the values of indicators NSi4.1, NSi4.2 and NSi4.3 for all member countries (ordered alphabetically). The performance is heterogeneous across countries, but some categorisation is possible. Some countries (BG, CZ, DE, EL, ES, HR, IE, LU and NO) score 100% in the value of NSi4.1, i.e. all their discovery services are conformant. Conversely, only EE and LT score 100% in NSi4.2 and only EE, LT and LU score 100% in NSi4.3. This means that **there is no single country scoring 100% for all the three indicators**, although there are countries overall performing well such as AT, CZ, DE, ES and HR. In contrast, a number of countries (CH, CY, FR, IS, IT, LI, MT and UK) score values equal or close to 0% for all the three indicators. However, the conformity of network services (which is only declared in the service metadata) does not impact on the actual accessibility of the data sets served by those services. Indeed, a comparison between the values of indicators NSi2, NSi2.1 and NSi2.2 with those of indicators NSi4, NSi4.1, NSi4.2, NSi4.3 and NSi4.4 for each country shows that services might be accessible (i.e. the Geoportal currently establishes linkages between the metadata of spatial data sets and spatial data services) but not conformant, or not accessible but conformant.

Figure 20. Values of indicators NSi4.1, NSi4.2 and NSi4.3 for all member countries



Source: JRC, 2020.

4 Discussion and conclusions

The 2019 monitoring and reporting process described in this report has ushered in a **new way to measure the status of implementation of the INSPIRE Directive**. For the first time in the Directive lifecycle, the activity was carried out in a fully automated way and was grounded on (some of) the central components, i.e. the INSPIRE Geoportal and the INSPIRE Reference Validator, that the JRC has developed in the recent years and currently operates. Driven by the recent Commission Decision (EU) 2019/1372, the new process allowed not only to make an objective assessment of the situation in each member country but also to compare the implementation progress across all countries. All of this was achieved through the calculation of a limited and informative set of indicators which, overall, provide a new baseline for monitoring the status and the future evolution of the EU SDI. In addition, from the user's perspective the introduction of indicators to automatically extract reference data sets for each member country, i.e. priority data sets as well as data sets with national and regional scope, is an important step to leverage the potential of the INSPIRE SDI as a whole.

From a more practical point of view, the whole workflow performed within the 2019 monitoring and reporting process, described in section 2.2, was coordinated and executed for the first time by the JRC (instead of the EEA) with contributions from the member countries. In contrast to all the previous monitoring and reporting rounds (Cetl et al., 2017), all the metadata harvested from the countries discovery services were processed in a fully automated way through both the INSPIRE Geoportal and the INSPIRE Reference Validator. In addition to improving the transparency and objectivity in the way indicators were calculated, the use of such software components provided a unique chance to successfully assess their stability and maturity and to improve them during the process. This was favoured by the very positive interactions established with the member countries representatives, who were involved in the whole activity and offered useful feedback (including suggestions and reports of bugs or inconsistencies based on their national results) in a kind of mutual learning process.

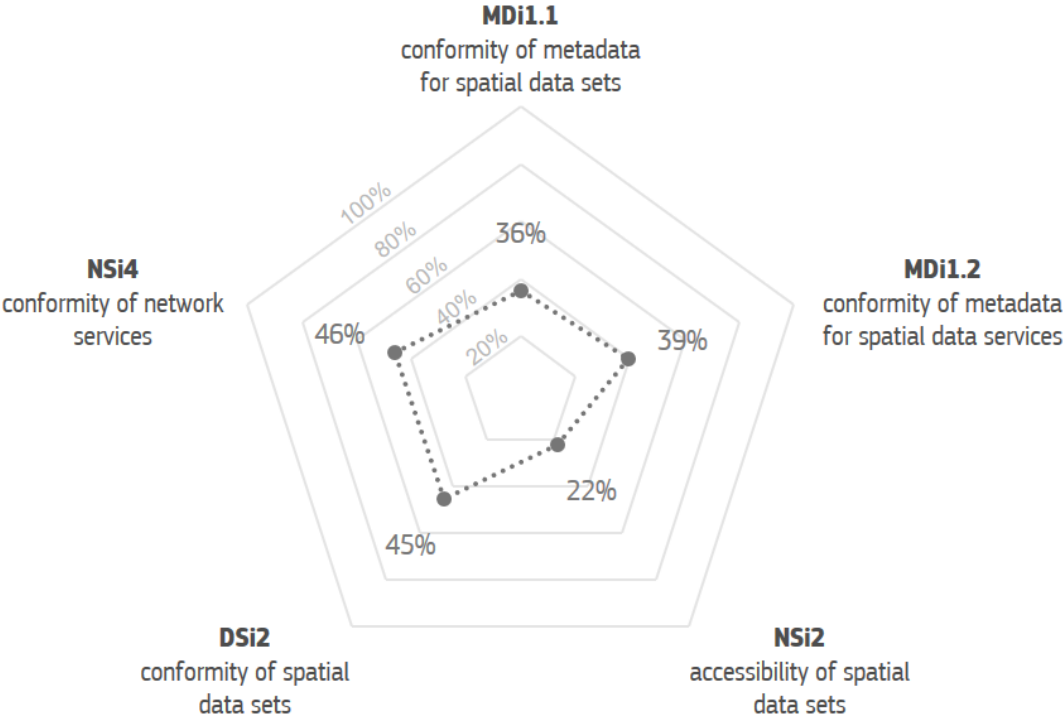
Based on the values of the 19 indicators calculated for all member countries (see Table 22), the main results of the 2019 INSPIRE monitoring and reporting process are discussed in the following. First and foremost, the results show that **the status of the implementation of INSPIRE is heterogeneous across countries**, and **there is no single country which has yet achieved full implementation** according to the roadmap⁽²⁹⁾, given that in an ideal situation all indicators expressed as percentages – with the exception of DSi2, DSi2.2 and DSi2.3 (whose deadlines are foreseen for 2020) – should have a value of 100%. The differences between member countries performance are obvious when looking at the minimum, maximum as well as the standard deviation of the indicator values, the latter being usually close to the mean value. The overall performance of each country as well as the comparison between two or more countries can be assessed from Table 22. While there are certainly some countries which overall outperformed others, there are also countries with high values of some indicators coupled with low values of other indicators.

Despite the clear differences in the implementation across countries, the results of the 2019 monitoring and reporting process allow also to draw some general conclusions on the different aspects of the implementation of INSPIRE. First, the **accessibility of INSPIRE data sets** – which is the main measure of the overall usability of the EU SDI – **is still low**: on average, only about 30% of the data sets are accessible through either a view or a download service while only 22% are accessible through both a view and download service, with some countries having percentages still equal or close to 0% (see subsection 3.1.4). This very low performance can be attributed to a number of reasons, including: the lack of view and download services; the presence of those services but the lack of correct links between their metadata and the data sets metadata; the presence of services which do not allow a direct access to the data sets (e.g. services protected by authentication) and the instability of the services themselves. Another conclusion deserving some discussion is the **low conformity of metadata**, which by definition represent the first building block of the whole INSPIRE infrastructure. Although the values of indicators MDi1.1 and MDi1.2 are very different across countries, the mean values of 36% and 39% of conformant metadata for spatial data sets and spatial data services, respectively, are very low and suggest that data providers have not extensively used the INSPIRE Reference Validator before the monitoring and reporting process. In the case of metadata for spatial data services, for some countries a reason for the low values of MDi1.2 was again the instability of such services. In addition, **almost all the metadata** harvested in December 2019 **were still encoded according to TG v. 1.3 despite the end of the transition period towards TG v. 2.0** (see subsection 3.1.2). **Conformity of spatial data sets**, and in particular of those corresponding to the themes listed in Annex I (whose deadline expired in 2017), **is also very heterogeneous and low on average**, with some countries providing very few or no interoperable data sets at all (see subsection 3.1.3). A similar conclusion applies to the conformity

⁽²⁹⁾ <https://inspire.ec.europa.eu/inspire-roadmap>

of network services, which is high for several countries while some others score percentages equal or close to 0%. However, it should be noted that the **lack of conformity of network services** does not necessarily imply the lack of accessibility of the spatial data sets served by these services (see subsection 3.1.5). The spider graph represented in Figure 21 summarises the above conclusions by plotting together the mean values of those indicators that overall provide a clear picture of INSPIRE implementation: MDi1.1 (conformity of metadata for spatial data sets), MDi1.2 (conformity of metadata for spatial data services), NSi2 (accessibility of spatial data sets), DSi2 (conformity of spatial data sets) and NSi4 (conformity of network services). Despite the high variability of the indicator values across countries, which would make the same graphs for all countries look very different from each other, **on average the combined performance is relatively low**. If the median values were considered instead of the mean values in order to get a more robust summary, the situation would be even worse (see the median values of the indicators in Tables 23, 25, 26 and 27).

Figure 21. Spider graph combining the mean values of indicators MDi1.1, MDi1.2, NSi2, DSi2 and NSi4

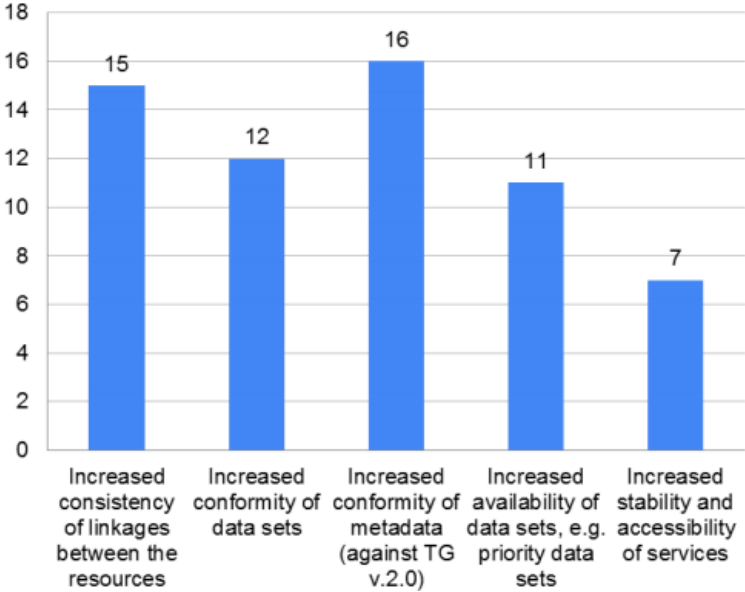


Source: JRC, 2020.

Following the publication of the 2019 monitoring and reporting indicators, a survey was prepared by the JRC to get some structured feedback from member countries on the overall process and final results. The survey was filled by 22 countries (AT, BE, BG, CY, DE, DK, EE, EL, ES, FI, FR, HU, IE, IT, LU, NL, PL, PT, RO, SE, SI and SK) and the main results are summarised in the following. When asked about the issues which led to low values of the indicators, the main answers received pointed to the change of the mechanism (now based on the INSPIRE Reference Validator, performing stricter checks compared to the past) to test metadata conformity, and the limited use of the Validator in preparation of the monitoring and reporting process; the presence of technical issues (of various types) with metadata harvesting; the complexity of the approach used by the INSPIRE Geportal to establish linkages between spatial data sets and services (see subsection 2.2.2); and the general lack of resources and know-how, especially from data providers, to better prepare to the monitoring and reporting process. Member countries were also asked where they would concentrate most of their efforts and investments to improve their score in the forthcoming 2020 monitoring and reporting process. The answers to this multiple-choice question are summarised in Figure 22, and reflect the importance given by the member countries to the improvement of metadata conformity and the consistency of linkages between spatial data sets and services. In contrast, only half of the countries are expected to prioritise the availability and the conformity of data sets, while even less interest is given to increasing the stability and accessibility of network services.

Regarding the conformity of metadata, countries were also asked to provide feedback on the usefulness of the supplementary material to the indicators MDi1.1 and MDi1.2 provided by the JRC to help understand the validation errors and identify the areas where most improvement is needed (see Figures 10 and 11). On a 4-level scale with values *very useful*, *somewhat useful*, *not very useful* and *not useful at all*, 11 countries chose *very useful*, 10 countries chose *somewhat useful* and only one country chose *not very useful*. The INSPIRE Reference Validator and the resource linkages checker tool, both operated by the JRC, were also recognized as **key resources to prepare for the future monitoring and reporting processes** and 18 out of the 22 countries which filled the survey stated that they already incorporated the use of these tools, or planned to incorporate them in the future, in their national workflow for the production of INSPIRE resources.

Figure 22. Areas where member countries will mostly focus their future efforts and investments, according to the answers to the survey distributed after the publication of results for 2019 monitoring and reporting



Source: JRC, 2020.

In conclusion, the 2019 INSPIRE monitoring and reporting was a successful process for both the European Commission and the member countries. While still reflecting a partial implementation of the Directive in line with previous assessments, with some countries clearly lagging behind (Cetl et al., 2017), the low values (on average) of the indicators were somehow expected given the drastic change in their calculation introduced by Commission Decision (EU) 2019/1372. The new automated approach based on the processing of all metadata harvested from member countries discovery services allowed to take stock of the INSPIRE implementation status, including identifying gaps, in a rigorous and objective way. This is why the results of the 2019 process represent a reliable baseline for monitoring the status and the evolution of the EU SDI in the years to come. Indeed, the availability and accessibility of INSPIRE data will play a key role for the successful establishment of the European Green Deal data space. In addition, INSPIRE data will significantly contribute to the definition and the provision of the high-value data sets defined in the Open Data Directive (European Union, 2019b).

Finally, the first-ever use of the INSPIRE Geoportal and INSPIRE Reference Validator for this process allowed not only to prove their suitability but also to identify limitations and weaknesses on both the technical and the management side, the latter connected to the need to provide the community with a clear and transparent release plan in advance of the annual monitoring and reporting deadline. Building on the results achieved for 2019 **the process is expected to improve significantly in the future**, fostering positive and transparent interactions between the member countries and the European Commission and bringing in turn an increasing impact on the implementation of INSPIRE in light of the forthcoming evaluation foreseen for 2022.

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List of abbreviations and definitions

API	Application Programming Interface
AT	Austria
ATS	Abstract Test Suites
BE	Belgium
BG	Bulgaria
CH	Switzerland
CY	Cyprus
CZ	Czech Republic
DE	Germany
DG ENV	Directorate-General for Environment
DG ESTAT	Directorate-General for European Statistics
DK	Denmark
EE	Estonia
EEA	European Environment Agency
EL	Greece
ELISE	European Location Interoperability Solutions for e-Government
ES	Spain
EFTA	European Free Trade Association
ETS	Executable Test Suites
EU	European Union
EUPL	European Union Public License
FI	Finland
FR	France
HR	Croatia
HTML	HyperText Markup Language
HU	Hungary
IE	Ireland
INSPIRE	Infrastructure for Spatial Information in the European Community
IS	Island
ISA ²	Interoperability solutions for public administrations, businesses and citizens
IT	Italy
JRC	Joint Research Centre
JSON	JavaScript Object Notation
LI	Lichtenstein
LT	Lithuania
LU	Luxembourg
LV	Latvia
MIG	Maintenance and Implementation Group

MT	Malta
NL	The Netherlands
NO	Norway
PDF	Portable Document Format
PL	Poland
PT	Portugal
REST	Representational State Transfer
RO	Romania
SDI	Spatial Data Infrastructure
SE	Sweden
SI	Slovenia
SK	Slovakia
TG	Technical Guidance
UK	United Kingdom

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