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SDI Monitoring Indicators Proposal

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Abbreviations

DRPM – Regional Directorate of Maritime Policies (Azores archipelago)
EC – European Commission
EU – European Union
GDS - Geographic Data Sets
MSP – Maritime Spatial Planning
SDI - Spatial Data Infrastructures
SDS - Spatial Data Services
ULPGC - University of Las Palmas de Gran Canaria (Canary archipelago)

1. Introduction

The following report falls within the scope of the project PLASMAR + (Progress of Sustainable Planning of Marine Areas in Macaronesia) regarding the activity 2.3.2 “DATA INFRASTRUCTURES AND PLATFORMS: Refining and Updating Marine Data Infrastructures and MSP Platforms”.

The maritime spatial planning (MSP) process builds upon the weighting between all uses and activities and law restrictions through a process based in the spatial analysis of each geographic layer as the main tool.

Structuring marine data in a Spatial Data Infrastructure (SDI) contributes to improve the data access and sharing with the sea stakeholders, approaching the citizen to the planning process.

This activity intends to improve the geographic marine datasets availability and access, through the creation of new datasets, new metadata to describe the datasets and new web services for an easy access.

During this work, whenever possible, requirements established by the Directive 2007/2/EC, and its related legislation, will be followed. The Directive 2007/2/EC, also known as INSPIRE, establishes an “European Union spatial data infrastructure for the purposes of EU environmental policies and policies or activities which may have an impact on the environment”. Through this directive, and all its related legislation, the European countries should follow the same rules and steps for their own SDI, including spatial datasets, metadata and web services. For example, rules for metadata are established in the Regulation (EC) n.º 1025/2008, and the interoperability of Geographic Data Sets and Services are established in the Regulation (EU) n.º 1089/2010.

Besides this, the SDI monitoring, as stated in the directive through the article 21.º and through the Commission Execution Decision (EU) 2019/1372, plays an important role to measure the performance, demand, availability and sharing of the geographical datasets.

Additionally, establishing a monitoring methodology will allow the evaluation of the project contribution for the SDI development and empowering the maritime spatial planning process.

This report intends to: (1) establish a list of indicators that could be capable to monitor different SDI’s; (2) provide the first indicators values in an initial moment, named Mi.

2. Spatial Data Infrastructures (SDI)

An SDI consists of a set of components that allow the storage, management, and availability of geographic data and their respective metadata associated.

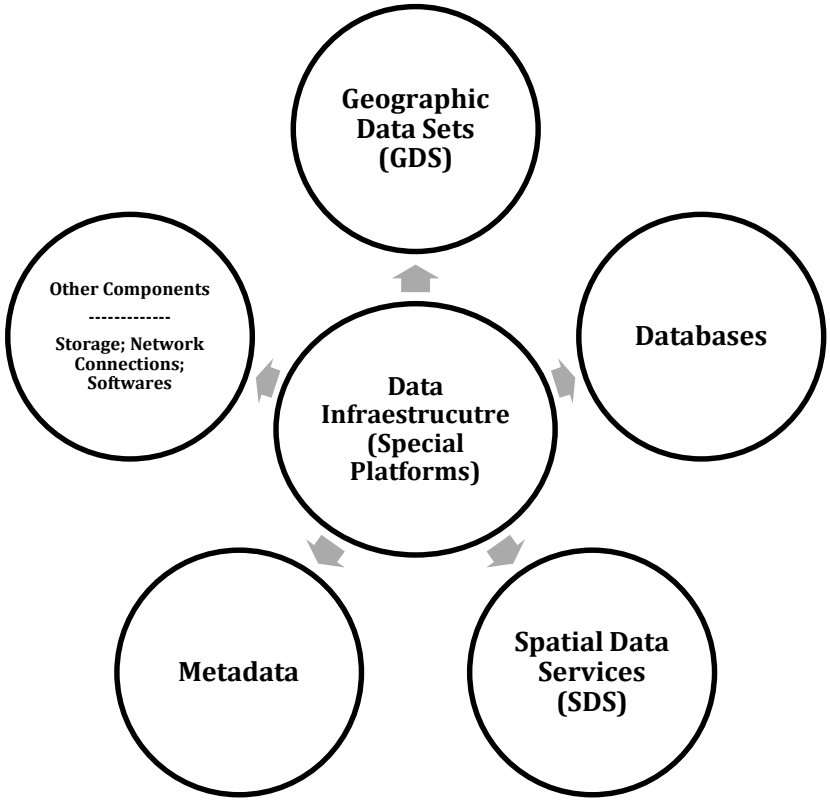


Figure 1 - Spatial Data Infrastructure Schematization

Regarding the previous schema, an SDI comprehends:

- Geographic Data
- Metadata
- Data Sets
- Availability Services of the Geographic Data
- Used equipment
- Human Resources
- All the other components that allow the SDI function

For this document, there will be considered two different SDI's regarding the 2 different involved partners: Regional Directorate of Maritime Policies (DRPM) from Azores and University of Las Palmas de Gran Canaria (ULPGC from Canary).

2.1. Azores– SDI SIGMAR

The Regional Directorate of Maritime Policies (DRPM) is the regional entity responsible for the administration and management of the marine environment and the implementation of the Maritime Spatial Planning (MSP) process in the Azores. In this context, geographic information usage, specifically related to the usages and conditionings in the Azores Sea, is an essential tool to fulfil its mission.

The compilation of the geographic information in an SDI allows the organization of the data and provides to third party users the ability to access it through web services and SIGMAR geoportal. SIGMAR geoportal is located on the Azores Regional Government communication infrastructure and is based on a Linux CentOS 8 virtual machine. On that virtual machine was installed the docker software alongside several containers. The usage of docker allows the different elements of the SDI to function independently resulting in more efficient management of the virtual machine allocated resources. With this technology docker allows individual containers for each component to interconnect like if they were individual machines.

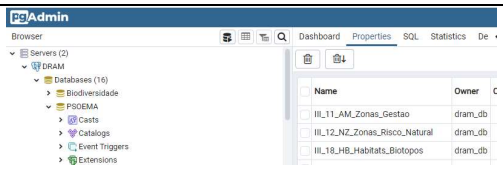
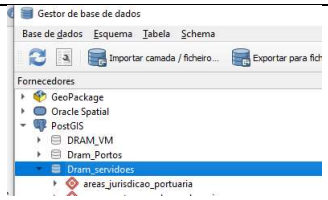
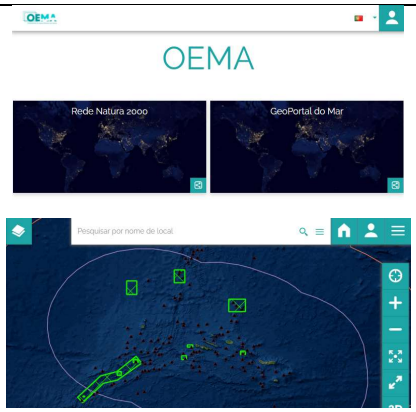
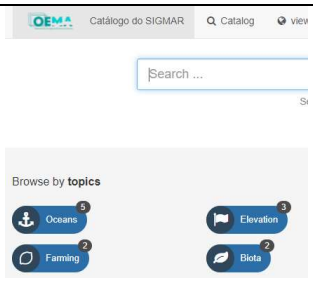
The main containers are:

- PostgreSQL Database: Includes a PostGIS extension installation, allowing to store geographic information;
- Geoserver: A server that creates and provides spatial data services based on PostgreSQL database;
- Mapstore2: A Platform that creates and provides a geoportal. It is linked to geoserver web services and geographical data. It allows the user to view and query the data through one or more viewer. A viewer is like folder in which the different layers of geographical data are organized;
- Geonetwork – Metadata warehouse and catalog solution providing storage and a management system.

Figure 2 - Organization schema of the main components in DRPM virtual machine using docker

All the used containers and their components described previously are open source and work independently, but they are integrated, allowing an optimization of the organization of all the SDI where in the Table 1 describes the main components of these containers.

Table 1 – Description of various components constituting the DRPM SDI

Components	
PostgreSQL - Open-source object-relational database system that uses and extends the SQL language combined with many features that store and scale the data workloads.(in https://www.postgresql.org/)	
PostGIS - Spatial database extender for PostgreSQL object-relational database. It adds support for geographic objects allowing location queries to run in SQL.(in https://postgis.net/)	
Geoserver - Server-based in open source Java GIS toolkit that allows users to view and edit geospatial data. For this, it uses open standards set forth by the Open Geospatial Consortium (OGC), allowing flexibility in map creation and data sharing.(in http://geoserver.org/)	
MapStore - Modular open source WebGIS framework developed to create, manage and share maps and mashups. This framework can mix map contents provided by servers compliant with OGC standards like WFS and WMS. As a standard geoportal, MapStore is used to find, view and query published geospatial data and to integrate multiple remote sources into a single map.(in https://mapstore.readthedocs.io/)	
GeoNetwork is a catalog application to manage spatially referenced resources. It provides powerful metadata editing and search functions as well as an interactive web map viewer.(in https://geonetwork-opensource.org/)	

2.2. Canary ULPGC SDI Presentation

HISTORIC BACKGROUND

The ULPGC launched its SDI through the domain www.geoportal.ulpgc.es in 2008. From the beginning of the activities of the PLASMAR Project (2017-2020) it was strongly developed both at the level of hardware and software support as well as contents. It currently has a dedicated server exclusively for the ULPGC environmental geoportal, within which the SDI is located.

ORGANIZATION BRIEF DESCRIPTION

The server under ULPGC SDI is running Ubuntu 20.04LTS as O.S. The rest of the installed programs are described in the following section. With respect to the organization of the datasets collected during the PLASMAR Project, it has been done through a repository organized by thematic folders indexed for each of the services. This repository is updated on demand from the local GIS workstation where the datasets are generated and/or collected.

SERVICES DESCRIPTION AND CURRENT CAPABILITIES

The SDI of the ULPGC currently offers the following services:

* WMS-WCS visualization service. Based on Geoserver software, it has 694 available layers served in version 1.3.0 of this OGC service.

http://www.geoportal.ulpgc.es/geoserver/ows?service=wms&version=1.3.0&request=GetCapabilities

* WFS download services. Also based on Geoserver software, it covers a total of 648 layers in version 2.0.0 of this OGC service.

http://www.geoportal.ulpgc.es/geoserver/ows?service=wfs&version=2.0.0&request=GetCapabilities

* Direct download service. Most of the compiled datasets are available for direct download compressed in ZIP format. There are 555 available whose links are referenced in the metadata and other services.

* Atom download service. Based on standardized subscription and news alert protocols. There is an Atom feed service covering all available datasets, also separated into 25 thematic services.

http://www.geoportal.ulpgc.es/atom/ecoaquaMSPatom.xml

* CSW catalogue service. Based on Geonetwork software, it supports harvesting operations and currently contains 650 records.

http://www.geoportal.ulpgc.es/geonetwork/srv/eng/csw?SERVICE=CSW&VERSION=2.0.2&REQUEST=GetCapabilities

* Metadata catalogue service. Also based on Geonetwork software, it includes a user interface for querying the metadata database. It currently contains 550 dataset metadata and 487 service metadata.

http://www.geoportal.ulpgc.es/geonetwork/srv/eng/catalog.search#/home

* Services catalogue. Own web development to compile the services presented in SDI. It is organized by topics and offers a summary and links to the different services contained in SDI.

http://www.geoportal.ulpgc.es/servicios/ecoaqua

* Web visualization service. Own web development based on OpenLayers libraries for visualization of datasets contained in the ULPGC SDI. There is a version that covers the entire catalogue and 22 thematic viewers referenced in the different services.

http://www.geoportal.ulpgc.es/visor2/?json=catalogo3.json#

INSPIRE IMPLEMENTATION

All the services offered by the ULPGC SDI, except the last two mentioned, have been developed following the OGC standards and with the technical requirements specified in the INSPIRE normative. As for the datasets, those resulting from projects carried out by this institute have been harmonized according to INSPIRE, with a total of 4 up to date.

ADDITIONAL TOOLS

As an aid to the maintenance of the ULPGC SDI, a proprietary VBA Excel application has been developed with the following functions:

- Coordination and management of unique metadata identifiers UUID.
- Coordination between local and server repository
- Creation of metadata .xml files.
- Metadata quality control including INSPIRE specifications
- Creation of Atom service .xml files
- Creation of service catalogue configuration files
- Creation of general and thematic viewer configuration files
- Coordination of cross-referencing between services
- Quality control of web services

CURRENT STATUS AND DEVELOPMENT PERSPECTIVES

The ULPGC SDI is considered stable since the last update of the server operating system made in September 2021. The workflow from obtaining a dataset to its publication in the SDI including the metadata has achieved a high level of development and efficiency. Likewise, the quality control tool created ad hoc has been in the process of continuous improvement and is currently achieving a high level of reliability.

The pending line of development is focused on providing all services with multi-language capabilities to extend the scope of data dissemination.

MONITORING SDI ELEMENTS

Except for the internal quality control performed by our own application, there is currently no indicator of activity or user demand of the elements that make up the ULPGC SDI.

3. Indicators Definition

PLASMAR is an international project that involves different partners where each one has its own SDI's based on different technologies. It was necessary to establish a direct, representable, and comparable monitoring methodology able to adapt to the different infrastructures.

The indicators identified are based on a SMART perspective and its monitoring period is based on the project timeframe, which has only one year left until the end, it was considered to measure a moment (Mi) referring to the initial situation in March 2022 and a second moment (Mf) referring to the situation on March 2023.

3.1. SMART Indicators

Regarding the development and progress of a project, activity, or program, the question to ask should be, "How do we know in what way or at what level are we achieving certain pre-established objectives or goals?"

By establishing an indicator or a set of indicators, we seek to define the starting point of analysis of our project and expect results established through objectives or goals achievable through the progress made within a certain period (McCord, A. et al, 2017).

As a way of establishing a set of indicators that allow a simple and reliable way to demonstrate the variations and changes over a certain period, is important to enable the understanding of possible differences, improvements, or developments regarding a given subject – final product, objectives, and goals**.**

Being thus able to provide information regarding the progress of the partners' SDIs, as a form of adequate framing of these indicators to the individual realities of the partners, an attempt was made to establish a set of SMART indicators that, according to Doran (1981), are deconstructed as it follows:

a) Specific

Establishing a particular subject or area

b) Measurable

Quantify or at least demonstrate an indicator of progress

c) Achievable

It should be achievable, taking into account the existing resources and who is responsible for the tasks, deadlines, and goals to meet

d) Result-Oriented/Realistic

The indicators must be considered in such a way that they result in a reliable interpretation of the results, considering the time frame established about the objectives or targets determined

e) Time-Bound

It should consider a time scale that allows a representative report of the results taking into account the scope applied

3.2. List of Indicators

Based on the objectives previously defined for its preparation, three sets of indicators were established:

- Direct Indicators;
- INSPIRE indicators;
- Access and Performance Indicators.

These sets of indicators should verify the following:

- existence of GDS in the SDI;
- variability of themes in the SDI;
- existence of web services;
- existence of a GDS with services;
- existence of metadata;
- metadata compliance;
- compliance of GDSs;
- compliance of the services;
- existence of viewers.

3.2.1. Direct indicators

For the monitoring of the previously described SDIs, direct and simple indicators were chosen. The direct indicators aim to be of unequivocal reading, based on counts, independent of the used technology and able to characterize the SDI in terms of geographic information.

a) Indicators that monitor the existence of GDS in the SDI:

- **N_GDS - Number of GDS in the SDI**

This general indicator intends to count the number of geographic data sets that the Spatial Data Infrastructure has at any given time. It will also serve to evaluate the project's contribution to increasing the existing geographic information.

- **N_GDS_I - GDS number of Annex I of the directive in the SDI**

This specific indicator intends to count the number of geographic data sets included in Annex I of the INSPIRE directive that the Spatial Data Infrastructure has at a given time.

- **N_GDS_II - GDS number of Annex II of the directive in the SDI**

This specific indicator intends to count the number of geographic data sets included in Annex II of the INSPIRE directive that the Spatial Data Infrastructure has at any given time.

- **N_GDS_III - GDS number of Annex III of the directive in the SDI**

This specific indicator intends to count the number of geographic data sets included in Annex III of the INSPIRE directive that the Spatial Data Infrastructure has at any given time.

- **N_GDS_MSP – GDS number related to MSP data framework**

This specific indicator intends to count the number of geographic data sets that are related to the MSP data Framework that the Spatial Data Infrastructure has at any given time.

b) Indicators that monitors the variability of INSPIRE themes in the SDI

- **N_T - Number of directive themes with GDS in the SDI**

The following indicator seeks to quantify the variability of themes in the annexes of Directive 2007/2/EC (INSPIRE) existing in the Spatial Data Infrastructure.

c) Indicators that monitor the existence of web services in the SDI

- **N_NS - Number of Network Services**

This general indicator intends to quantify the number of network services available in the SDI. Corresponds to the sum of N_DCVS, N_VS, N_DS, and N_TS indicators;

- **N_DCVS - Number of Discovery Services**

This specific indicator quantifies the number of discovery services that exist in the SDI.

- **N_VS - Number of View Services**

  This specific indicator quantifies the number of view services in the SDI.

- **N_DS - Number of Download Services**

  This specific indicator quantifies the number of download services in the SDI.

- **N_TS - Number of Transformation Services**

  This specific indicator quantifies the number of transformation services existing in the SDI.

d) Indicators that monitor the existence of GDSs with services in the SDI:

- **N_GDS_DVS - Number of geographic data sets with both WMS and WFS services;**

This indicator aims to identify, among the existing GDSs, which have both view and download services (WMS and WFS)

- **N_GDS_VS - Number of geographic data sets with WMS services**;

  This indicator intends to quantify the GDSs that have view services (WMS)

- **N_GDS_DS - Number of geographic data sets with WFS services;**

  This indicator intends to quantify the GDSs that have offload services (WFS)

e) Indicators that monitor the existence of metadata in the SDI:

- **N_GDS_M - Number of GDS with metadata in the SDI**

This general indicator looks to quantify the number of spatial data sets for which metadata exists, regardless of whether or not they comply with the provisions of Regulation (EC) No 1025/2008.

- **N_GDS_MI – Number of GDSs with Annex I metadata of the directive in the SDI**

This specific indicator aims to quantify the number of spatial data sets in Annex I to the Directive for which metadata exists, regardless of whether or not they comply with the provisions of Regulation (EC) No 1025/2008.

- **N_GDS_MII – Number of GDSs with Annex II metadata of the directive in the SDI**

This specific indicator aims to quantify the number of spatial data sets in Annex II of the Directive for which metadata exists, regardless of whether or not they comply with the provisions of Regulation (EC) No 1025/2008.

- **N_GDS_MIII – Number of GDSs with metadata from Annex III of the directive in the SDI**

This specific indicator aims to quantify the number of spatial data sets in Annex III of the Directive for which metadata exists, irrespective of whether or not they comply with the provisions of Regulation (EC) No 1025/2008.

- **N_SDS_M - Number of SDS with metadata in the SDI**

This indicator aims to quantify the number of spatial data services for which metadata exists, regardless of whether or not they comply with the provisions of Regulation (EC) No. 1025/2008.

f) Indicators that monitor metadata compliance in the SDI:

- **N_GDS_MC – Number of GDSs with metadata compliant in the SDI**

This indicator intends to quantify the number of spatial data sets for which metadata comply with Regulation (EC) No 1025/2008. Compliance is verified by testing the metadata files submitted to the "INSPIRE Reference Validator".

- **N_SDS_MC - Number of SDS with Conforming metadata in the SDI**

The number of spatial data services for which the metadata complies with Regulation (EC) No 1025/2008.

g) Indicators that monitor GDS compliance in the SDI:

- **N_GDS_C - Number of Geographic Data Sets compliant in the SDI**

This general indicator aims to quantify the number of spatial data sets by Regulation (EU) No. 1089/2010.

- **N_GDS_CI - Number of Geographic Data Sets compliant with Annex I of the directive in the SDI**

This specific indicator aims to quantify the number of spatial data sets in Annex I of the Directive that comply with Regulation (EU) No 1089/2010.

- **N_GDS_CII - Number of Geographic Data Sets compliant with Annex II of the directive in the SDI**

This specific indicator aims to quantify the number of spatial data sets in Annex II of the Directive that comply with Regulation (EU) No 1089/2010.

N_GDS_CIII - Number of Geographic Data Sets compliant with Annex III of the directive in the SDI

This specific indicator aims to quantify the number of spatial data sets in Annex III of the Directive that comply with Regulation (EU) No 1089/2010.

h) Indicators that monitor the compliance of Network Services in the SDI:

- **N_NS_C - Numbers of Compliant Network Services**

This general indicator intends to quantify the number of network services made available in the SDI, which complies with Regulation (EC) No. 976/2009. Corresponds to the sum of N_DCVS_C, N_VS_C, N_DS_C, and N_TS_C indicators.

- **N_DCVS_C - Number of Compliant Discovery Services**

This specific indicator quantifies the number of discovery services existing in the SDI, which comply with Regulation (EC) No. 976/2009.

- **N_VS_C - Number of Compliant View Services**

This specific indicator quantifies the number of view services existing in the SDI, which comply with Regulation (EC) No. 976/2009.

- **N_DS_C - Number of Compliant Download Services**

This specific indicator quantifies the number of download services existing in the SDI that comply with Regulation (EC) No. 976/2009.

- **N_TS_C - Number of Conforming Transformation Services**

This specific indicator quantifies the number of transformation services existing in the SDI, which comply with Regulation (EC) No. 976/2009.

i) An indicator that monitors the existence of viewers in the SDI:

- **N_GEO - Number of viewers on the Geoportal**

This indicator aims to assess the process of integrating information into the SDI, through the creation of thematic viewers that allow users to access in a more targeted and efficient way a set of related geographic information.

3.2.2.INSPIRE indicators

In addition to the direct indicators, this work also intends to use some of the indicators defined in Commission Decision 2019/1372/EC, of 19 August, thus allowing to be possible to compare the results of this monitoring with the national INSPIRE results.

In this way, the INSPIRE indicators serve to monitor:

- The availability of geographic data and services (article 3);
- Metadata compliance (article 4);
- The compliance of spatial data sets (article 5);
- Accessibility of GDSs through viewing and downloading services (article 6);
- Compliance of network services (article 7).

The following tables describe these indicators in detail. Note that only data sets with metadata will be considered in these indicators.

Table 2 - Indicators that monitor the availability of data and geographic services, regarding Article 3 of Commission Implementing Decision (EU) 2019/1372, of 19 August 2019

Indicators	Formula	Description
DSi1.1	-	Number of geographic data sets which contains metadata correspondent to the direct indicator **N_GDS_M**
DSi1.2	-	Number of spatial data services to which contains metadata corresponding to the direct indicator **N_SDS_M**
DSi1.3	-	Number of GDS with keywords related to the values list at https://inspire.ec.europa.eu/metadata-codelist/PriorityDataset
DSi1.4	-	Number of GDS with the keyword “Regional”
DSi1.5	-	Number of GDS with the keyword “Nacional”

Table 3 - Indicators that monitor the metadata compliance, regarding Article 4 of Commission Implementing Decision (EU) 2029/1372, of 19 August 2019

Indicators	Formula	Description
MDi1.1	$\frac{N\_GDS\_MC * 100}{N\_GDS\_M}$	The percentage of metadata for geographical data sets that are in conformity
MDi2.1	$\frac{N\_SDS\_MC * 100}{N\_SDS\_M}$	The percentage of metadata for spatial data services that are in conformity

Table 4 - Indicators that monitor the compliance of Geographic Data Sets, regarding Article 5 of Commission Implementing Decision (EU) 2029/1372, of 19 August 2019

Indicators	Formula	Description
DSi2	$\frac{N\_GDS\_C * 100}{N\_GDS\_M}$	Percentage of geographic data sets complying with Regulation (EU) No 1089/2010 regards their interoperability
DSi2.1	$\frac{N\_GDS\_CI * 100}{N\_GDS\_M\_I}$	Percentage of geographic data sets, from Annex I of the Directive, in compliance with Regulation (EU) No 1089/2010 regards their interoperability
DSi2.2	$\frac{N\_GDS\_CII * 100}{N\_GDS\_M\_II}$	Percentage of geographic data sets, from Annex II of the Directive, in compliance with Regulation (EU) No 1089/2010 regards their interoperability
DSi2.3	$\frac{N\_GDS\_CIII * 100}{N\_GDS\_M\_III}$	Percentage of geographic data sets, from Annex III of the Directive, in compliance with Regulation (EU) No 1089/2010 regards their interoperability\

Table 5 - Indicators that monitor the accessibility of Geographic Data Sets through the view and data download services, regarding Article 6 of Commission Implementing Decision (EU) 2029/1372, of 19 August of 2019

Indicators	Formula	Description
NSi2	$\frac{N\_GDS\_DVS * 100}{N\_GDS\_M}$	Percentage of CDG with WMS and WFS
NSi2.1	$\frac{N\_GDS\_VS * 100}{N\_GDS\_M}$	Percentage of CDG with WMS
NSi2.2	$\frac{N\_GDS\_DS * 100}{N\_GDS\_M}$	Percentage of CDG with WFS

Table 6 - Indicators that allow monitoring the compliance of network services with Regulation (EC) No. 976/2009, by Article 7 of Commission Implementing Decision (EU) 2029/1372, of 19 August 2019

Indicators	Formula	Description
NSi4	$\frac{N\_NS\_C * 100}{N\_NS}$	Percentage of compliant network services
NSi4.1	$\frac{N\_DCVS\_C * 100}{N\_SS}$	Percentage of compliant discovery services
NSi4.2	$\frac{N\_VS\_C * 100}{N\_VS}$	Percentage of compliant view services
NSi4.3	$\frac{N\_DS\_C * 100}{N\_DS}$	Percentage of compliant download services
NSi4.4	$\frac{N\_TS\_C * 100}{N\_TS}$	Percentage of compliant transformation services

3.2.3.Access and Performance Indicators

Monitoring requests made to the spatial data server allows a better understanding of the demand for geographic information, their trends, as well as the performance of the services.

a) To monitor and understand the demand for services, there are the following proposed indicators:

- **N_REQ/Month – Number of requests (requests) per month**

The idea behind this general indicator is to quantify the number of requests on the view (WMS) and download (WFS) services per month. This indicator is the sum of the specific indicators N_REQ_WMS/Month and N_REQ_WFS/Month.

- **N_REQ_WMS/Month – Number of requests (requests) for viewing services per month**

This specific indicator intends to quantify the number of requests for view services (WMS) that the spatial data server receives per month.

- **N_REQ_WFS/Month – Number of requests (requests) for download services per month**

The intention for this specific indicator is to quantify the number of download service (WFS) requests that the spatial data server receives per month.

b) To monitor the performance of services, there are the following proposed indicators:

- **Performance/Month – Average access time to WMS and WFS services per month**

This general indicator intends to quantify the average access time to the view (WMS) and download (WFS) services that the spatial data server receives per month. This indicator is the sum of all accessed times for view and download services divided by the total number of view and download requests.

- **WMS_Performance/Month – Average access time to WMS services per month**

This specific indicator intends to quantify the average time of access to the view services (WMS) that the spatial data server receives per month. This indicator is the sum of all access times for view services divided by the total number of view requests.

- **WFS_Performance/Month – Average access time to WFS services per month**

This specific indicator intends to quantify the average time of access to the download services (WFS) that the spatial data server receives per month. This indicator consists to the sum of all access times for download services divided by the total number of download requests.

Indicators	Formula	Description
Perf/month	$\frac{\sum tr_{wms} + \sum tr_{wfs}}{Nr_{wms} + Nr_{wfs}}$	Average access time to WMS and WFS services per month
Perf_WMS/month	$\frac{\sum tr_{wms}}{Nr_{wms}}$	Average access time to WMS services per month
Perf_WFS/month	$\frac{\sum tr_{wfs}}{Nr_{wfs}}$	Average access time to WFS services per month

Where,

$\sum tr_{wms}$	Sum of all the times that each WMS request took in one month
Nr_{wms}	Number of WMS requests in a month
$\sum tr_{wfs}$	Sum of all times that each WFS request took in one month
Nr_{wfs}	Number of WFS requests in a month

4. Monitoring process

To help the monitoring process, this section presents tables to be filled in, at least, two monitoring moments: Initial Moment (Mi) - Baseline; and Final Moment (Mf).

4.1. Direct Indicators

Table 7 – Monitoring Direct Indicators Table at Mi

Existing GDS	N_GDS (Total)	
	N_GDS_I (Anexo I)	
	N_GDS_II (Anexo II)	
	N_GDS_III (Anexo III)	
	N_GDS_MSP	
Variety	N_T	
Existing services	N_NS (Total)	
	N_DCVS	
	N_VS (WMS)	
	N_DS (WFS)	
	N_TS	
Existence of GDS with services	N_GDS_DVS (WMS + WFS)	
	N_GDS_VS (WMS)	
	N_GDS_DS (WFS)	
Existence of metadata	N_GDS_M (Total)	
	N_GDS_MI (Anexo I)	
	N_GDS_MII (Anexo II)	
	N_GDS_MIII (Anexo III)	
	N_SDS_M	
Metadata conformity	N_GDS_MC	
	N_SDS_MC	
GDS conformity	N_GDS_C (Total)	
	N_GDS_CI (Anexo I)	
	N_GDS_CII (Anexo II)	
	N_GDS_CIII (Anexo III)	
Service conformity	N_NS_C (Total)	
	N_DCVS_C	
	N_VS_C (WMS)	
	N_DS_C (WFS)	
	N_TS_C	
Existing viewers	N_GEO	

4.2. Inspire indicators

Regarding the indicators defined in Commission Implementing Decision 2019/1372/EC, of 19 August, the DRPM's SDI does not currently store or make available geographic environmental reporting data, this means, data that is associated with the reporting of environmental directives, so, the DSi1.3 indicator will be 0 ('zero'). Likewise, this SDI is also not responsible for providing geographic data whose scope is national, so the value of the DSi1.5 indicator will also be 0 ('zero').

The indicators on the compliance of network services with Regulation (EC) No. 976/2009 (indicators NSi4; NSi4.1; NSi4.2; NSi4.3 and NSi4.4), it is currently not possible to conform them, therefore, the result for all of them will be 0 ('zero').

Table 8 - Monitoring INSPIRE Indicators Table at Mi

Geographic Services and Data Availability	DSi1.1 (N_GDS_M)	
	DSi1.2 (N_SDS_M)	
	DSi1.3 (Priority)	
	DSi1.4 (Regional)	
	DSi1.5 (National)	
Metadata Conformity	MDi1.1 (GDS)	
	MDi1.1 (SDS)	
Geographic Data Sets Conformity	DSi2 (Total)	
	DSi2.1 (appendix I)	
	DSi2.2 (appendix II)	
	DSi2.3 (appendix III)	
Accessibility of Geographical Data Sets through data view and download services	NSi2 (WMS + WFS)	
	NSi2.1 (View - WMS)	
	NSi2.2 (Download - WFS)	
Network Services Conformity	NSi4 (Total)	
	NSi4.1 (Research)	
	NSi4.2 (View - WMS)	
	NSi4.3 (Download - WFS)	
	NSi4.4 (Transformation)	

4.3. Access and Performance Indicators

This set of indicators will only be possible to monitor at moment Mf after some time elapsed since the start of monitoring.

5. Expected evolution for the Mf moment

5.1. Direct Indicators

Table 9 - Monitoring Direct Indicators Table at Mf

Indicator Type	Indicator	Moment Mi	Moment Mf
GDS Existence	N_GDS (Total)		
	N_GDS_I (Anexo I)		
	N_GDS_II (Anexo II)		
	N_GDS_III (Anexo III)		
	N_GDS_MSP		
Thematic Variety	N_T		
Service Existence	N_NS (Total)		
	N_DCVS		
	N_VS (WMS)		
	N_DS (WFS)		
	N_TS		
Existence of GDS with Services	N_GDS_DVS (WMS + WFS)		
	N_GDS_VS (WMS)		
	N_GDS_DS (WFS)		
Metadata Existence	N_GDS_M (Total)		
	N_GDS_MI (Anexo I)		
	N_GDS_MII (Anexo II)		
	N_GDS_MIII (Anexo III)		
	N_SDS_M		
Metadata Conformity	N_GDS_MC		
	N_SDS_MC		
GDS Conformity	N_GDS_C (Total)		
	N_GDS_CI (Anexo I)		
	N_GDS_CII (Anexo II)		
	N_GDS_CIII (Anexo III)		
Service Conformity	N_NS_C (Total)		
	N_DCVS_C		
	N_VS_C (WMS)		
	N_DS_C (WFS)		
	N_TS_C		
Viewers Existence	N_GEO		

5.2. INSPIRE Indicators

Table 10 - Monitoring INSPIRE Indicators Table at Mf

Indicator Type	Indicator	Moment Mi	Moment Mf
Availability of Geographic Data and Services	DSi1.1 (N_GDS_M)		
	DSi1.2 (N_SDS_M)		
	DSi1.3 (Priority)		
	DSi1.4 (Regional)		
	DSi1.5 (National)		
Metadata Conformity	MDi1.1 (GDS)		
	MDi1.1 (SDS)		
Geographic Data Sets Conformity	DSi2 (Total)		
	DSi2.1 (appendix I)		
	DSi2.2 (appendix II)		
	DSi2.3 (appendix III)		
Accessibility of Geographical Data Sets through Data View and Download Services	NSi2 (WMS + WFS)		
	NSi2.1 (View - WMS)		
	NSi2.2 (Download - WFS)		
Network Services Conformity	NSi4 (Total)		
	NSi4.1 (Research)		
	NSi4.2 (View - WMS)		
	NSi4.3 (Download - WFS)		
	NSi4.4 (Transformation)		

5.3. Measurement/Monitoring

Considering the need to understand the evolution of the various elements of the SDI, it has been set to achieve this understanding through the production of quarterly readings with exposure of the values obtained through the implementation of the indicators established in 3.2 section, allowing a relevant assessment of the teams and the respective information/resources made available.

6. Expected Results

PLASMAR + is a project that intends to support the maritime spatial planning process and aims to leverage the increase of geographic information made available to all those who are interested in the planning process, especially the maritime space users.

The definition of the goals to be achieved at the end of the project, as well as the respective execution of the various objectives established by the project, will demonstrate an evolution about the initial operational capability of the partners' SDIs respecting the various principles emanating through Directive 2007/2/EC.

Using the studies, methodologies, and tools developed during the execution of the project there is an expectance that they will serve for a better implementation of the MSP in Macaronesia, as well as complementing the existing knowledge about the marine environment of Macaronesia.

In this sense, the valorisation of aspects such as performance, capacity, availability, and response time of the SDIs seeks to emphasize, for example, institutional elements, the constitution of tools, monitoring, and transparency of the entire process of creating and managing geographic information.

Since the intention of increasing the number of GDS's available in the SDI's, the existence of metadata and/or the existence of services which allow data to be shared are also objectives of this project it allows the monitoring the percentage of archiving the objectives established for the two monitoring periods, Mi and Mf.

This evolution aims to provide an understanding of the progression, not only in terms of aggregated information at the level of the SDI but also, and mainly, in terms of information and services that allow the users to access the various levels of information.

Thus, to obtain knowledge regarding the progress in obtaining, processing, and availability of information of a geographic nature, it is essential that monitoring is coherent and continuous. This way it will aggregate the most complete panorama as possible to understand the real gaps in terms of information and services in each respective SDI's beyond the ending period of PLASMAR + project.

By following these steps, it is possible to assume that there are tools capable of carrying out greater transparency of the processes of creation and sharing of geographic information.

This way, there is the expectation of aggregating all the information available for visual access and downloading on the respective project partners' platforms or even in future new platforms to manage other types of data, generating new opportunities to create transversal projects.

7. References

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