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Agenda item 3. Review of Proposed IMAP Common Indicator Guidance Facts Sheets

Progress achieved with regards to IMAP Information System

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Draft Feasibility Study of the Pilot Information System (PIS) for IMAP Common Indicators

List of Abbreviations/Acronyms

COP	Conference of Parties
EcAp	Ecosystem Approach
ETL	Extract, Transform, Load
GES	Good Environmental Status
IMAP	Integrated Monitoring and Assessment Programme
LBS	Land-based sources
MPA	Marine Protected Areas
NAP	National Action Plans
NIS	Non-indigenous species
PIS	Pilot Information System
RBDMS	Relational database management system
UN Environment	United Nations Environment
UN Environment/ MAP	United Nations Environment– Mediterranean Action Plan
W3C	World Wide Web Consortium

I. Introduction

1. Premise

1. The establishment of an adequate information system to support IMAP implementation is a key priority for UN Environment/MAP in line with the MAP Mid Term Strategy 2016-2021 (Decision IG.22/1) and the 2016-2017 MAP Programme of Work (Decision IG.22/20), as well as with the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (Decision IG 22/7).

2. In line with the above, the focus of the work of INFO/RAC has been to undertake a Mediterranean specific assessment (user need analysis) on how to further develop the UN Environment/MAP InfoMAP platform in line with other regional data-management platforms/reporting obligations, with inter-operability and capable data-management system.

3. INFO/RAC, in full compliance with the needs of MAP system, and for the implementation of Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (IMAP) is aiming to provide a technology platform for the management of information from all datasets related to marine ecosystem investigations under its mandate.

4. The platform should allow:

- comply with the information requirements in the light of the obligations laid down in the Barcelona Convention;
- evaluate, define and monitor decision-making strategies through achieving the goal of appropriateness and usability of the data.

5. In order to achieve the above, with the support of the Ecap-MEDII project, the creation of the PIS (Pilot Information System), including the integrated communication infrastructure, is of particular importance. PIS will have to collect and integrate data from different sources.

6. The following document provides information, quantitative and qualitative data to characterize both the current operational situation for the proper framing of the functional aspects required for the new PIS as a tool capable of managing the overall information and to characterize the technological and functional aspects considered critical and essential to which the executive project will have to adhere.

2. Background

7. The 19th Meeting of Contracting Parties (COP 19), held in February 2016, adopted the Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria (Decision IG. 22/7), with a list of regionally agreed good environmental status descriptions, common indicators and targets, with principles and clear timeline for its implementation.

8. IMAP, through Decision IG.22/7 lays down the principles for an integrated monitoring, which will, for the first time, monitor biodiversity and non-indigenous species, pollution and marine litter, coast and hydrography in an integrated manner. As such, IMAP aims to facilitate the implementation of article 12 of the Barcelona Convention and several other monitoring related provisions under

different Protocols with the main objective to assess GES. Its backbone are the 11 Ecological Objectives and their 27 common indicators as presented in Decision IG. 22/7.

9. The UNEP/MAP Programme of Work (PoW) adopted at COP 19, includes Output 1.4.3 for the Implementation of IMAP (the EcAp-based integrated monitoring and assessment programme) coordinated, including GES common indicators fact sheets, and supported by a data information centre to be integrated into Info/MAP platform.

3. Relevant MAP Supporting Documents

10. A number of assessment products have been prepared by the Secretariat since the adoption of the Ecosystem Approach Roadmap, with the contribution of Contracting Parties, all MAP Components, relevant partners and regional stakeholders, with the view to provide a clearer image of the state of environment in the Mediterranean, and define the main drivers, pressures and impacts as well as their anthropogenic sources.

11. More in particular:

a. The **Initial Integrated Assessment of the Mediterranean Sea and Coastal Areas** was prepared in 2011, based on available knowledge and information. This initial assessment was undertaken at sub-regional and regional levels. A summary for decision makers, providing the main findings and priorities was submitted and endorsed by the COP17 with its Decision IG. 20/4.

b. In addition, the **State of the Mediterranean Marine and Coastal Environment Report** (SoER MED 2012) was prepared and published in 2012, which provides valuable information on the main human induced pressures, the state and impacts on the Mediterranean Ecosystems, while its last part presents the regional regulatory framework and identifies gaps and key steps for the implementation of the Ecosystem Approach.

c. The third assessment report since the adoption of the Ecosystem Approach Roadmap is the **Quality Status Report 2017**. Based on the COP 19 Decision on the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (IMAP, Decision IG. 22/7) and the MAP Programme of Work 2016-2017 (Decision IG.22/20), UN Environment/MAP Secretariat with the input of all components and the experts of the various Correspondence Groups on Monitoring (CORMONs) have prepared the draft Quality Status Report (QSR 2017).

d. The draft QSR 2017 is fully based on the **IMAP Common Indicators**, using data provided by the Contracting Parties and MAP RACs or collected through research projects and made available by other sources of information.

e. The preparation of QSR 2017 followed a multi-step comprehensive review process, which has involved all relevant MAP Components, the CORMON experts, MAP Component Focal Points and Ecosystem Approach Coordination Group. Key partners such as the GFCM and ACCOBAMS have also contributed to this process.

f. In line with the above, **Indicator Guidance Fact Sheets** have been developed for each Common Indicator to ensure coherent monitoring, with specific targets defined and agreed in order to deliver the achievement of Good Environmental Status (GES) and as such, provide concrete guidance and references to Contracting Parties to support implementation of their revised national

monitoring programmes towards the overall goal of implementing the Ecosystem Approach (EcAp) in the Mediterranean Sea and achieveing GES.

g. The structure of a **Common Indicator Factsheet** can be summarized looking at the different organization levels of the developed factsheet templates. A common set of relevant policy and science based information is required on each (ie. Indicator Title, Rational, Policy Context and Targets, Indicator analysis methods and Methodolgy for monitoring (temporal and spatial scope), Contacts and Document Registration). In each, detailed definitions, methodologies, references, gaps, uncertainties, data analysis approaches, basis for aggregation (if applies) and outputs complete the guidance factsheets.

4. National Monitoring Programmes

12. COP19 adopted the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and related Assessment Criteria (IMAP, Decision IG.22/7).

13. The IMAP sets out all the required elements to establish the first region-wide Integrated Monitoring and Assessment Programme, covering for the first time in an integrated manner monitoring and assessment of biodiversity and fisheries, pollution and marine litter, coast and hydrography, based on region-wide common indicators.

14. The core of IMAP are the 23 regionally-agreed common indicators and the 4 candidate indicators, for which latter, scientific knowledge and information is not yet fully developed to allow for regional monitoring and assessment, but for which Contracting Parties are encouraged to develop pilot monitoring programmes.

15. Overall the IMAP indicators cover 9 out of 11 Ecological Objectives, namely the EO1, EO2, EO3, EO5, EO7, EO8, EO9, EO10, EO11.

16. The IMAP provides base for the further development of candidate indicators towards common indicators, based on outcomes of pilot monitoring activities, additional expert knowledge and scientific development. It also foresees the further refinement of specifics of agreed common indicators, in particular on geographical scales.

17. The IMAP implementation covers the period from 2016 to 2021, same of the second cycle of the ecosystem approach. During the initial phase of IMAP (2016-2019) all the Contracting Parties to the Barcelona Convention are expected to update their national monitoring and assessment programmes in line with IMAP structure and principles and based on the agreed common indicators. In this respect, UN Environment/MAP has been providing support to the Southern Mediterranean Countries to develop their national IMAP with the support of the EcAp-MEDII EU funded project.

18. In the framework of the MAP POW and with the support of the EcAp-MEDII project, work is ongoing to develop and or update national monitoring programme to implement IMAP. Furthermore various country trainings, capacity-building activities have been carried out, such as the most recent training on monitoring techniques of the common indicators related to biodiversity and non-indigenous species, held in the coastal MPA of the Kuriat island (Tunisia, July 2017). A second training is planned in September 2017, in Samos Island, Greece. Two country training workshops on Coast and Hydrography were already organized in Rabat, Morocco (October 2016) and in Rome, (April 2017). . Pollution and litter country trainings are planned between September-November 2017.

19. The development of the integrated national monitoring programmes are also under-way, with final drafts available on Biodiversity and NIS up to date, for Egypt and Lebanon. National workshops for the discussion and the validation of the national IMAP in Libya, Morocco and Tunisia were already organized to agree on the list of species and habitats to be considered while implementing the monitoring programme, as well as the monitoring areas.

20. In addition, next to national implementation, work has been ongoing in line with IMAP also on regional level, with four additional CORMON Meetings held (CORMON Pollution, CORMON Litter, CORMON Biodiversity and Fisheries and CORMON Coast and Hydrography), in order to further specify monitoring and assessment technicalities of IMAP design and implementation.

21. Plan Bleu is responsible for coordinating the "Strengthening of the Science-Policy Interface (SPI)" component which aims at promoting and encouraging exchanges between scientists and environmental decision makers. Though the importance of science for environmental policy making is recognized as essential, the dialogue between scientists and managers is not easy, mainly because the timeframe of scientific research is not the same as the one of management. Moreover, strengthened SPIs are particularly important to optimize the implementation of IMAP at national level. Indeed, the SPI enables scientists to better assist decision makers in monitoring and assessment to achieve good environmental status (GES). SPIs also ensure that policymakers are aware of existing scientific projects and provide recommendations. Considering that only a small fraction of relevant marine scientific knowledge is actually used for management and implementation of marine policies, five regional SPI workshops took place between December 2015 and April 2017 gathering scientists and decision makers to discuss pre-determined issues, mainly the gaps in scientific knowledge compromising the full implementation of the IMAP.

The five regional workshops are: the Inception Meeting on SPI strengthening, a thematic SPI workshop in line with the CORMON on Pollution, a thematic SPI workshop back to back with the 2nd Forum on Mediterranean MPA and Marine Biodiversity, an integrated SPI workshop on the Risk-based Approach and a joint SPI workshop on the definition of relevant scales for monitoring and assessment.

II. State of play analysis of Information Systems

22. The implementation of the MEDPOL Programme required collection of monitoring data on concentration of contaminants included in a specific list on hotspots. Such data have been collected in MEDPOL monitoring data base through a dedicated web application that is currently managed by INFO-RAC. It is planned that also marine litter monitoring data should be collected into MEDPOL monitoring data base (**MPIS**).

23. Data regarding National Base Budget (**NBB**) will also be collected by a dedicated web application and stored in a relational data base system. Both web applications are available to Contracting Parties focal points responsible for collection and transmission of data to UN Environment/MAP.

24. Consistency of data in MEDPOL monitoring data base varies between Contracting Parties with long time series and rather substantial amount of data and other with very short time series and sparse data. Although IMAP indicators on contaminants and eutrophication address different aims with respect to MEDPOL monitoring programme, there is common information that will require to streamline the two data flows.

25. Information standards for the collection of monitoring data represent the first fundamental step in this process and they do not have to be confused with the process of the implementation of indicators which is still on-going and implies the definition of common specific and quantitative indexes and metrics to be used on collected monitoring data used to calculate the indicators.

26. InfoMAP as a node to be developed for the collection and sharing of monitoring data and the implementation of IMAP indicators, has started with a proposal of information standards for the collection of monitoring data.

27. Marine monitoring programs have a consolidated history that goes back to the 70s-80s and have been further developed in the framework of European Union (EU) Directives on coastal (WFD – 2000/60/CE) and marine waters (MSFD) for Contracting Parties who are also Members of the EU. As such on the last 15-10 years some Mediterranean countries have already implemented monitoring programs and collected data according to shared information standards which contribute to many IMAP indicators.

28. IMAP indicators also cover issues that have not been formally standardized and some of these are rather new and challenging from the monitoring protocols point of view (for ex. marine litter). Furthermore, Countries usually implement monitoring programme through regional environmental agencies, research institutes, national/local observatories that jointly participate to monitoring/research projects at the Mediterranean level where information standards on monitoring programme data collection have been proposed for some specific issues.

29. Taking into account such context, the first proposal of information standards for the collection of monitoring data is based on the **Indicator Guidance Fact Sheets** where the method including standards etc. are defined.

III. Requirements of the Pilot Information System (PIS)

30. The PIS is intended as a system for evaluating new procedures for handling data in which a sample that is representative of the data to be handled is processed. The main requirement will be cooperation between the different categories of users, of which the subjects are primarily addressed to PIS, as direct or indirect users, and which are the following:

- UN Environment/MAP;
- INFO/RAC;
- MAP Components;
- Contracting Parties;
- MAP Focal Points (MAP FPs);
- International Institutes;
- National Institutes

1. Non-functional requirements

1.1. General requirements

Support

31. The PIS will have to play a supporting role, so it must be able to provide information and summary data that will also identify critical issues and possible rationalizations both in the internal context and in relationships with external entities such as data providers.

Resources

32. The resources needed to manage the system must be minimized, while respecting service quality levels. Systems and IT environments will therefore have to be highly efficient and reliable.

Scalability

33. The platform should cope and perform under an increased or expanding workload, providing with the possibility of integrating application, adding modules and technological infrastructure even at later times, to manage increased needs.

Open technology

34. For investment protection, the platform must use open, flexible and sound technology based on standard and de facto widespread standards (such as ISO, OGC, OPEN WEB etc.) nowadays available. This means to have flexibility, and the knowledge and confidence to make future-proof technology investments, and the ability to extend and enhance software to meet their needs so to have broad possibilities of integration to the outside IT environment.

Architecture

35. In compliance with regulatory, operational, resource and budget constraints, the choice of a "**modular**" architecture will allow a more flexible planning of the software development process, as long as the design of the internal modules and their relationships follows a unified vision.

Organizational requirements

36. The PIS must play a central role in supporting the whole process. It will therefore have to avoid rigidity of the processes, and in fact guarantee high adaptability, easy activation of new procedures or reconfiguration of existing ones.

Technological requirements

37. The PIS will have to meet the following technological requirements:

Modular programming

38. A modular information system will be developed in terms of modules and components around different modules that encompass a cohesively whole solution or system. Each module will contain everything necessary to execute only one aspect of the desired functionality. A module interface expresses the elements that are provided and required by the module. The elements defined in the interface are detectable by other module.

39. This allows the system to expand through the composition of a personalized solution obtained by combining the only modules of interest.

User interface

40. Must be conceived to ensure usability through product and process. It must be assured that the interface has elements that are easy to access, understand, and use to facilitate actions. The most common criteria of software ergonomics, such as: consistency, efficiency, design, memory and context help, will be used.

Application logs

41. The production process must generate a file of events that are logged by the software application. It should contains errors, informational events and warnings. The application log mechanism must be fully configurable both in terms of size and tracking level.

Database

42. Must be of a relational type that can ensure transactionality, multi-user, concurrency and, where required by the data schema, compliance with the rules of referential integrity; it must be periodically updated, scalable, assuring portability between different platforms and equipped with a sound back-up system to manage data recovery in case of failures of the system.

Internet Technologies

43. Must be used Open web technologies as described in the Open Web Platform by the World Wide Web Consortium (W3C).

Application Integration

44. The solution must have the ability to share information and services with external systems, both as a data exchange opportunity and as a means of providing external functionality (RACs, Countries, Research Organizations, Institutions, etc.).

1.2. Functional requirements

45. Below there are the functional requirements that will characterize the information system:

ETL (Extract, Transform, Load)

46. The feeding and updating of the analytical database is in itself the most delicate and characteristic part of the whole discipline. The ETL process is developed through the implementation of automated procedures for extracting data from homogeneous or heterogeneous sources, performing intermediate processing for storing in the proper format or structure for the purposes of querying and analysis, and finally loading the flow into the target database.

47. The key feature required for the ETL module is that the user must be able to design and implement the necessary procedures in intuitive visual environments (which do not require the user to know any programming language).

Manual Data Entry

48. To assist user in manual insertion of information specific web form must be developed, in order to reduce the probability of errors, (if possible and if the number of alternatives is reasonable) the selection mode from list values rather than mere typing must be chosen. However, the formal correctness, consistency and plausibility of the entered data shall be checked.

Reporting

49. Reporting refers to the documents that are to be produced from database queries in order to comply with both internal and external information requirements.

50. All information presented to the user must be able to be printed or exported in the most common formats to ensure integration and data exchange with other application environments. Therefore, the main feature of the reporting tool is the availability of a visual editor that allows you to create reports easily and intuitively and the ability to export documents in various formats (.pdf, .html, .doc, .rtf, .txt, .xls, .csv).

51. The reporting system allow Contracting parties to produce their own reports for policy makers.

Dashboards

52. Interactive dashboards will be implemented to manage a series of operations such as:
- displaying charts or synthetic charts;
- producing reports;
- management of the compilation phase of the reporting modules;
- interchange of data.

Data Mining

53. In addition to the classic charts, dashboards, and reports, the platform will need to use tools to perform advanced statistics. The availability of huge amounts of data allows the application of statistical techniques falling within the Data Mining.

Web portal

54. The platform will have to be able to be run on a web portal, developed with the Internet Technologies previous described, that allows its data feeding, and the publication of the produced information outputs.

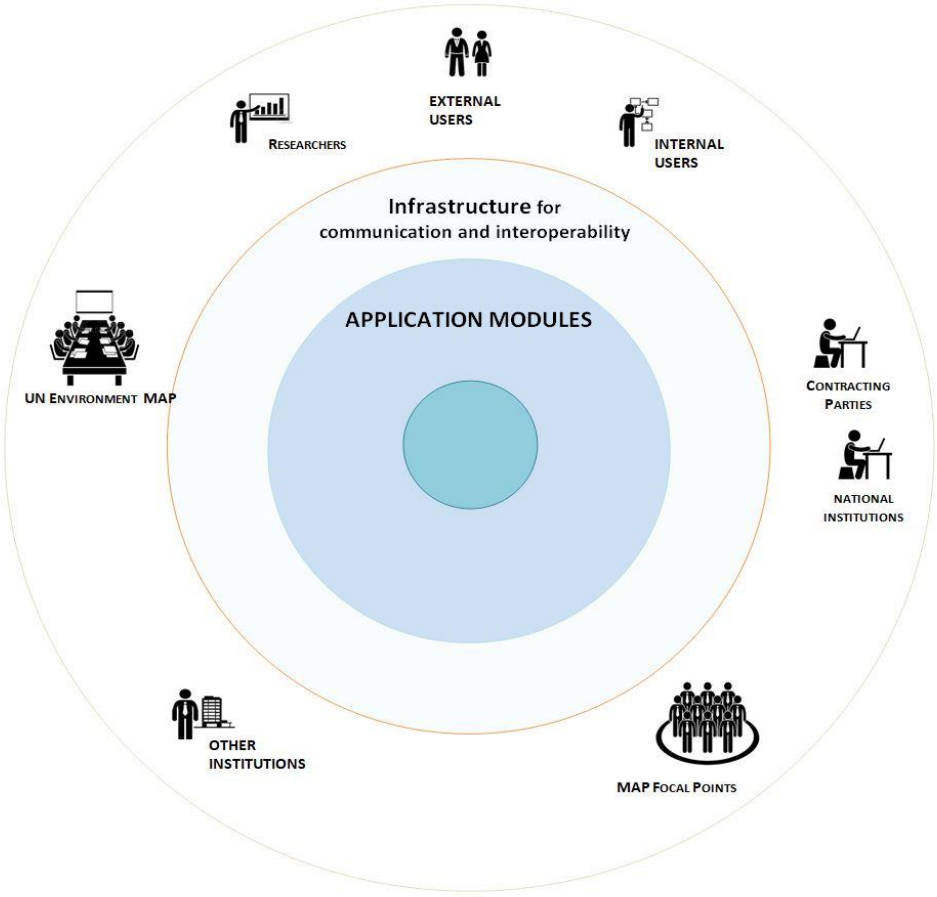
IV. Components of the Pilot Information System (PIS)

1. General characteristics

55. The Pilot Information System (PIS), from a global point of view, must be presented and operate in a highly integrated way, guaranteeing the data sharing with agreed policy.

56. It is therefore a central core represented by a common database, by a set of autonomous application modules (software components) and by an infrastructure for communication and interoperability with other systems.

57. The figure below is the conceptual model of the proposed PIS. In the external circle users are represented at the same level. Of course the system allows the hierarchical distribution of users (external circle) according to Contracting Parties needs.



58. The modular approach allows to considerably reduce the complexity of the system implementing it as a set of distinct components that can be developed independently and then plugged together.

59. The modular structure also provides great interoperability between functional application components that meet the need for integration, while remaining autonomous and independent both operational and functional.

60. The proposed solution envisages a PIS not only modular but also scalable, that is to say that it can be functionally upgraded with the addition or development of new application modules, and capable of managing the increments of traffic and users expected and desirable, simply by increasing the processing and / or transmission capacity.

2. Software Components

2.1. Application software components – database

61. The technology platform on which the application solutions will be hosted will have to provide as the main base component the **Database**, which will have the following features:

- it must be based on relational systems that will allow all types of data and information to be managed;
- must use query, reporting and reporting languages, based on standard SQL (ISO/IEC 9075);
- it must ensure transactionality, multi-user, concurrency and wherever required by the data schema, respect for referential integrity.

62. A portion of the database (catalog or dictionary) contains a centralized description of the data (metadata), which can be used by all modules.

63. In particular, the catalog should include all the metadata on:

- stations / areas;
- parameters;
- habitats;
- assessment areas;
- species list;
- unit of measure;
- laboratories;
- users;
- etc.

64. The logical structure of the database will be described in the form of Entity–relationship diagrams with standard SQL database creation scripts. It will be produced a documentation to define the typology and characteristics of each field in the tables, the existing constraints on the fields and among the fields, and ultimately providing precise information about the data use mode. The documentation must also be consistently aligned with the actual database structure.

2.2. Application software components - elaboration

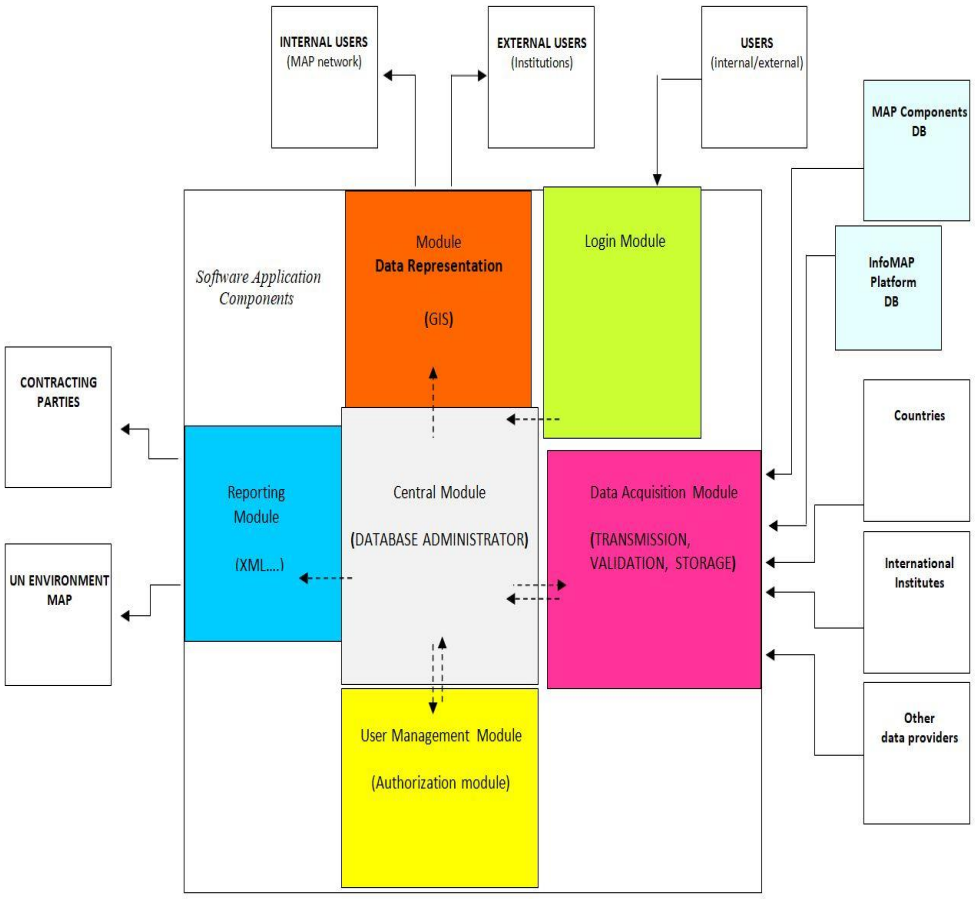
65. The logical architecture of the system, as mentioned above, is flexible and modular and lends itself to being combined in a broad spectrum of architectural solutions: from monolithic, hosted on a single server, to more complex situations such as virtualization technique at logical and physical level.

66. Six main modules are defined:

1. **CENTRAL MODULE**
2. **DATA ACQUISITION MODULE**
3. **REPORTING MODULE**
4. **DATA REPRESENTATION MODULE**
5. **USER MANAGEMENT MODULE**
6. **LOGIN MODULE**

67. The **CENTRAL MODULE** is responsible for database management and is the module through which all other application components communicate.

68. The logical architecture is represented in the following diagram:



Logical Architecture of the Pilot Information System

2.2.1. *CENTRAL MODULE*

69. The Central Module has the task of storing, organizing, centralizing and making available all the information.

70. It will therefore have to be able to handle:

- all types of data and information that are involved in the monitoring activity;

- the congruence and consistency of the information entered and / or modified.

71. However, the form must allow not only to manage the current data, but also to historicize the data and information useful to reporting, analysis, etc.

72. It must also provide backup procedures (eg incremental, integral, etc.) and restore procedures to minimize the risk of information loss.

73. All static data will be managed through a web based interface.

74. The module allows through the catalogue management to share information in an up-to-date format and stay aligned after each change.

2.2.2. *DATA ACQUISITION MODULE*

75. The definition of data acquisition refers to the set of procedures by which the data sent from the periphery to the centre is subjected to a set of controls defined by appropriate rules before it can be inserted into the consolidated database.

76. The system of rules to be built will have to be based on the consistency between the boost towards the central government and the instances of autonomy of the suburbs, without forgetting that the central government will still remain the functions of addressing, coordinating and controlling.

77. It was intended to identify the procedures:

- data transmission;
- validation of data (formal check, consistency check ...);
- data storage.

Data Transmission

78. The monitoring data collection function must be based on the application of precise rules as described in the **Indicator Guidance Fact Sheets** for each indicator. A prerequisite will be the assurance that data production through monitoring activities is managed in a uniform and standardized way through a systematic approach.

79. In order to transmit the information from the periphery to the infoMAP platform in a congruent and consistent manner, the following actions must be implemented:

- design of information flows:
  - analysis of the information that should be made available at the national level by peripheral systems (RACs, Countries, National institutes, etc.) and identification of information should be returned from central to peripheral level;
  - defining the channels through which this information should be transmitted (transmission mode).
- creating information and coding standards in line with community standards.

80. The proposal of information standards as a collection of names, definitions, and attributes about data elements that are being used for data exchange, in line with IMAP Common Indicators and data user needs, is elaborated by INFO/RAC, according to the **Indicator Guidance Fact Sheets**. These information standards are made up of a set of spreadsheets containing detailed data tables and data dictionaries supported by compilation guidelines to ensure that the data can be easily verified, analyzed and clearly interpreted. The information standards will be uploaded on the repository of the PIS.

Validation of data

81. The reliability of an entire set of data collected in the various monitoring surveys is a cornerstone of the decision-making process that accompanies the whole process.

82. The checks to be carried out are both formal and coherent:

Formal check

83. Validation procedures will be implemented to check the formats (text, date/time, numerical, boolean), minimum and maximum size, specific constraints on numerical intervals and expressions, and compliance where relevant with default enumeration lists, and so on.

Consistency check

84. The need to validate the data is obvious: the data collected are affected by multiple sources of error (sampling, analytic and "intrinsic") whose single evaluation is not absolutely determinable. The validation procedure has the task of applying the established criteria (eg statistical methods) to the data set that allow to calculate concentrations and / or measurements corresponding to a predetermined probability level. If you choose a data transfer via XML, the procedure will apply to the file (XML) formal checks and data consistency and will operate in two phases:

- Phase 1: Provides formal checks on an XSD schema. Failure to comply with these checks causes the entire XML file to be lost;
- Phase 2: (only accessible if Phase 1 checks are exceeded) involves applying data consistency checks. Failure to comply with these controls implies the scrap of the single record and not the entire XML file.

85. Therefore, the system should include the implementation of application modules for the quality control of analytical and cartographic data, with particular reference to: control of the data format (text, numeric, date, logical, etc.), compliance with lists of predefined values, consistency with acceptable range of values, geographic correctness of both punctual and polygonal information. Control procedures should be implemented in such a way as to allow the user to validate appropriate parameters without any modification of the software application module. The list of control procedures must be indexed and managed using a specific application form that contains each code, description, target, and output procedure. The control procedure target can be a table on the relational database or a .xls, .xlsx, .mdb, .csv file in a default schema.

86. The output of control procedures must be returned in .csv, .xls, and xlsx format and inserted into dedicated tables in the relational database. The “unit control procedure” is a single control to be performed on a specific analytic field of a table: the date format, the numeric format, and the text format, etc.

87. If there are multiple fields of the same format on the same table or on different tables, the number of unit controls is equal to the number of fields to be controlled: i.e. if there are two data format fields in a table and a data format field in another table, the number of unit controls is 3.

88. Unit controls must be implemented by software procedures executable on a given field of a particular table regardless of the number of records in the table. Topological controls on cartography are not included in the unit control procedures and will be performed by experienced INFO/RAC staff.

Data storage

89. The procedure is to consolidate validated data through storage operations in order to keep the information in time and to find them easily. The amount of information to be collected is such that the data for being properly managed must be stored in a precise way so that search and consultation can be managed as efficiently as possible.

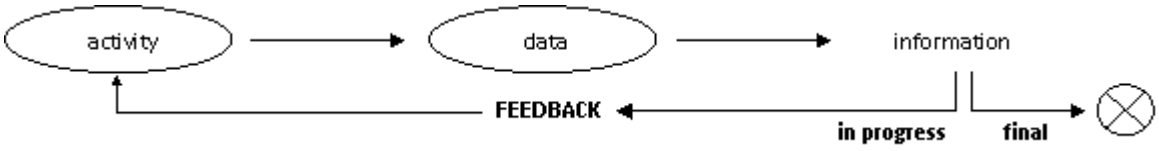
2.2.3. *REPORTING MODULE*

90. The module will handle the reporting process by providing reporting creation and management capabilities, as well as with predefined reports that can:

- respect the information needs of the Barcelona Convention protocols and requirements therein specified;
- meet administrative requirements;
- allow more complex and articulate analysis activities for decision making purposes.

91. The module will systematically and articulate the extraction and correlation of data subject to reporting.

92. The reporting process is described in the diagram below.



2.2.4. *DATA REPRESENTATION MODULE*

93. Organized, validated and archived data are usable and can be consulted according to the data policy that will be agreed with the Contracting Parties. This module manages the process of interpretation, analysis and representation of data in order to produce "knowledge".

94. Through the Web-Gis tool, the module will use tools to represent information designed to make the data not only visible but also comprehensible.

95. Within the scope of the PIS for the purpose of processing data into information, it is necessary to implement a software tool falling within the general typology of the Information Design Tool, which offers a platform capable of "defining, planning and giving shape to a content considering the

context in which it is presented, with the aim of meeting the information request of the recipients "(International Institute for Information Design).

96. The following minimum functionalities required for this type of software tool (Information Design Tool type) based on the main features, data aggregation capabilities, and data analysis properties:

Main features

- intuitive and interactive visual exploration;
- geographic display of data distribution related to monitored phenomena;
- identification of areas of interest to conduct in-depth analysis;
- display of georeferenced elements (common, sites, stations, points of interest ...) with clustering and punctuation.

Data aggregation and metadata

- correlation between information from different sources to obtain aggregate information;
- "data set" information merge according to common parameters or based on the distance between the georeferenced elements (common, sites, stations, points of interest);
- export of aggregated data to standard interoperable formats (excel, csv);
- description of metadata with ISO profile in accordance with the guidelines by using a web editor for their compilation;
- MS service implemented according to ISO standards (NETWORK SERVICES);

Data analysis

- charts and dashboards;
- navigable and exportable reports in Excel, etc;
- data segmentation (eg smart data browser);
- analyzes and views can easily be "cloned" in other areas of interest for immediate comparisons.
- search the metadata catalogue integrated into the GIS viewer so that it can be accessed on the same web page:

    - the display of the cartographic layers in a default folder list;
    - the search and selection of map layers on the metadata catalogue;
    - adding a mapping layer selected by the dot to the list of map layers in view.

2.2.5. *USER MANAGEMENT MODULE*

97. Data stored in the PIS must be protected by readings and / or modifications by unauthorized users. This module has the task of ensuring adequate security criteria and meeting current security standards when accessing each information.

98. The User Management Module establishes the user's rights to information configuring users, user groups, authorization profiles, and access privileges in terms of applications, application and data functions. For each configured user, the operating role to which it can be associated must be defined.

99. The module must allow:

- password assignment as well as management in terms of complexity, length and validity over time;
- detection of access anomalies, such as failed attempts, simultaneous access by the same user, etc
- instant control of all connected users;
- the session closes automatically after the expiration of a confusing period of inactivity.

100. Finally, the module will have to provide a log file that can trace the activities of each user continuously. All traced operations can be viewed by users with special permissions (i.e super-user) in order to identify and analyze operational critical situations.

2.2.6. *LOGIN MODULE*

101. The PIS must be accessible through a single desktop form from which to activate all applications. The form will need to use a web user interface, probably offered directly on the institutional site. This would allow the advantage of using a single entry point to ensure security of access.

102. The Login module will need to integrate applications from all other modules by providing the same presentation layout and dynamically integrating all controls regarding user privileges, features that can be activated for each application, and the data that each user can manipulate.

103. The number of applications available must also depend on the level of security for which the user is credited and in accordance with what is configured in the user management module.

2.3. Applicative Software Components – publication

2.3.1. Technology Infrastructure

104. The SW architecture will have to take into account the needs of collecting, processing and publishing the web of sea-to-sea monitoring data. As a result, two operating environments are identified:

- Data processing and consultation environment - client side
- Processing, consulting and publishing environment - server side

2.3.2. Data processing and consultation environment - client side

105. The web client for the data processing must operate within a web browser window but which functions are a set of separate application.

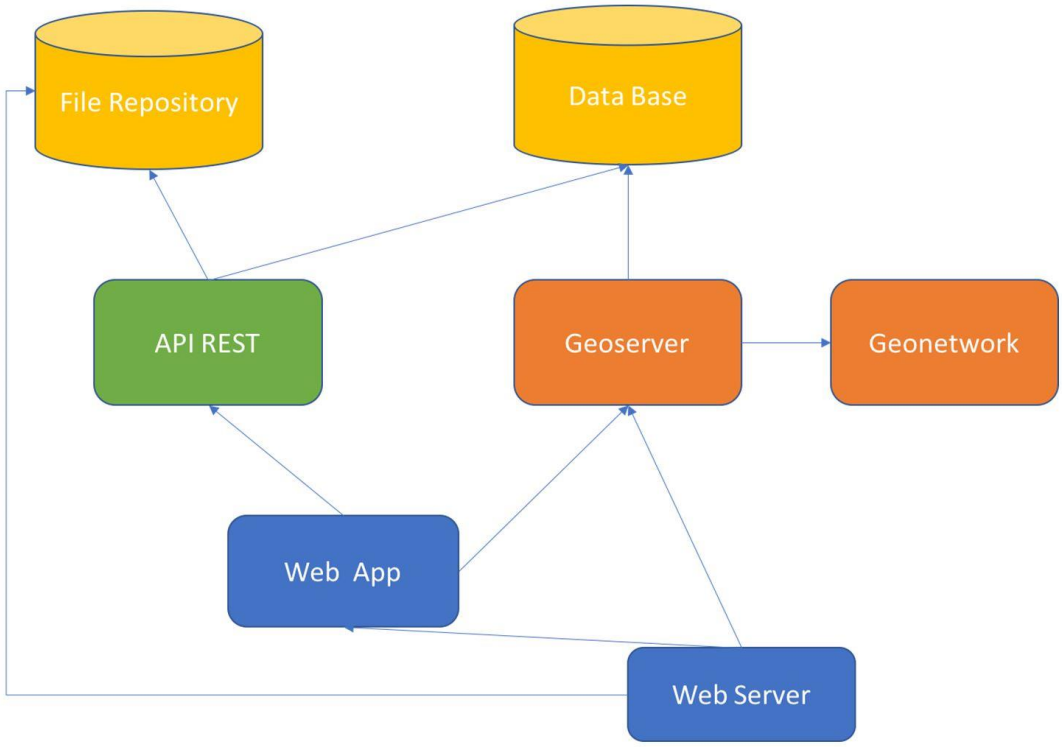
2.3.3. Processing, consulting and publishing environment - server side

106. This environment must be endowed with open-source software which can provide backup and restore functions in line with enterprise applications.

107. Application software must be such as to guarantee the functionality required in this with particular regard to the functions of:

- RDBMS (Relational database management system)
- Application server
- Web GIS server

108. The solution provided is composed of the following software modules linked according to the following architectural diagram:



109. In particular, every component is realized by the following technology solutions:

- **Web Server: Apache** It is responsible for management of each HTTP/HTTPS requests from the web portal and connects to Web App, Geoserver or File Repository according to specific functionalities
- **Web App**: developed in nodeJS and AngularJS technologies with Model-View-Controller architecture. It is responsible for login, user management, information standard management, files uploads and connects to Geoserver for WEB GIS functionalities. It also connects to Data Base by API REST (Application programming interface) modules for the queries on user and monitoring data;
- **Geoserver: GeoServer** It allows to publish and manage GIS layers, web GIS services, WMS and WFS services. It connects to Data Base for the publishing of monitoring data on geodatabase and to Geonetwork for GIS layers catalogue
- **Geonetwork: GeoNetwork** It manages GIS layers and services catalogues also in compliance with ISO 19215
- **API REST**: nodeJS and Json. It maps File repository and Data Base information to HTTP requests and allows Web App communications. It is also responsible for the

implementation of quality data control on monitoring files and compliance with information standards;

- **Data Base**: PostgreSQL and PostGIS It is a relational data base management systems with GIS extension for the collection of user information, monitoring data also with geographical features, information standards and monitoring files. It is equipped with scheduled back-up procedures;
- **File repository**: json. It allows storage of monitoring files, information standards and any other files relevant for the systems, assigning a unique identifier for each files and mapping the physical file on the file system to the logical file requested by Web App and stored on Data Base.

110. The system is realized with open source software distributed with Open GML user license and it is scalable and portable on Linux and Windows operating systems. It offers web services and pages accessible by widespread browser like Chrome, Firefox, IE, etc.

V. Process of data processing

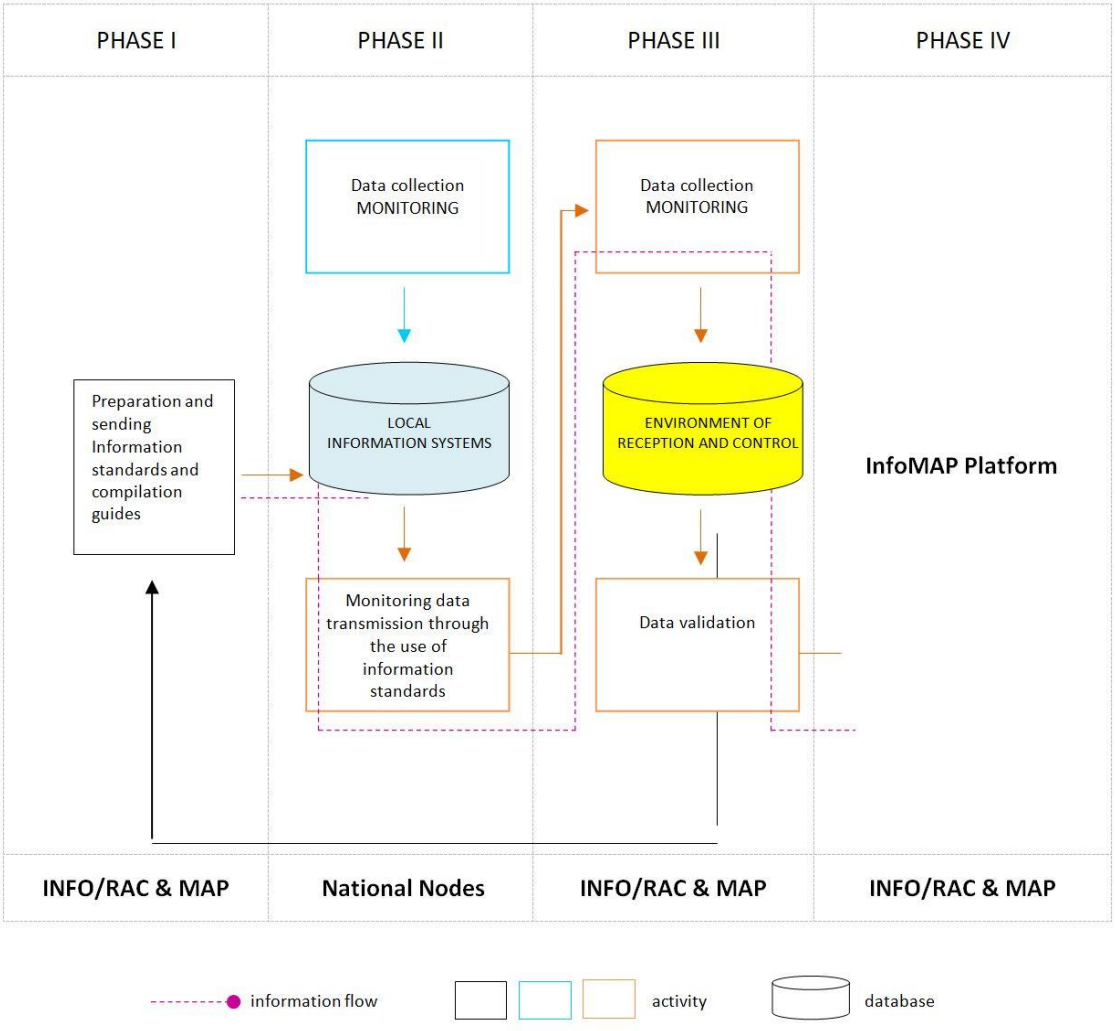
111. The PIS will need to be able to handle several heterogeneous data flows, such as:

- data deriving from monitoring programmes implemented pursuant to IMAP;
- relevant data used for IMAP assessment, including socio economic, definition of GES and determination of environmental targets;
- data belonging to other existing databases of MAP Components (included or not yet in the InfoMAP Platform).

1. Information flow

Scenario

112. Information flow is represented in the underlying scenario according to four distinct processing phases. The stages are in progressive sequence. For each phase, the tasks to be performed are distinguished.



2. Data Processing Phases

113. The following steps are described in detail in the above paragraph and related to the processing of data from the monitoring:

PHASE I. Preparation of the information standards and their guidelines

114. The information system shall be made available to the monitoring actors, information standards and the technical guidelines for their compilation. The information standards contain the list of information to be provided (i.e. name of monitoring station and geographic coordinates, monitored parameter, monitoring methodology adopted). For each single information to be provided, the information standard should indicate:

- field name (i.e. PARAMETER);
- field format (one selected from: text, numeric, yes / no, date);
- any list of eligible values (i.e LIST OF CHEMICALS MONITORED or LIST OF SPECIES);
- description of the field;
- permissible range of values (i.e from 0 to 100 per percentage).

115. Typically, the information to be provided is aggregated for tables that have relationships between them. A table containing the information for the monitoring stations/areas, one for the values of the monitored parameters. In the guide to compiling the information standard, information on the relationships between the different tables must be provided. There may be static information defined once for all (the list of substances to be monitored or the list of monitoring station codes). Such lists, generally called master records, will have to be included in the technical guidelines. The format for the information standard can be CSV, XML or EXCEL.

PHASE II. Transmission and collection of data deriving from monitoring programs through information standards

116. Monitoring operators, after obtaining the information standards made available by the information system in accordance with paragraph 1), compile the data resulting from the monitoring itself. The properly compiled information standard form represents the format by which the monitoring data is collected by the operators and transmitted to the Information System. Transmission modes will be all implemented and could be chosen by the users according its level of computerization.

117. Generally, the following modes are identified:

(A) the monitoring data is inserted into a CSV, XML or EXCEL file and sent to the system by manual uploading on a dedicated web page;
(B) the monitoring data is inserted into a CSV, XML or EXCEL file and made available on a folder of a server with regularity to be agreed upon. The information system retrieves periodically the available files on the server folder ;
(C) monitoring data is inserted into a CSV file and transmitted in real time to the information system by automated procedures.

118. Each of the modes described above has advantages and disadvantages:

Case A) The operator has greater control over the data in the compilation and transmission phases, but must manually carry out the transmission.

Case B) It is not necessary to proceed with manual transmission but it is sufficient to deposit the files into a shared folder. This, however, involves the presence of a network server that is always accessible and managed by the operator.

Case C) Suitable for telemetry stations, the monitoring operator has little control over the transmission but is responsible for the physical maintenance of the monitoring station.

PHASE III. Control, validation and aggregation of data

119. Once you have collected data at the information system using one of the methods described in step 2 above, you must check and validate the information. In general, it is possible to identify the following types of controls:

Formal checks:

- data compliance checks on the single field:
    - field format (text, numeric, yes / no, date);
    - value entered according to the list of possible values;
    - entered value within the permissible range;
- data compliance checks on single field column:
    - single value entered in relation to the values entered across the table column (eg univocity of the station code).
    - data compliance checks against values entered in different tables (relational controls) i.e. the congruity of the station code in the station table with respect to the station code entered in the parameter values table.

120. Consistency checks:

- parameter-specific range checks (i.e. 0-14 for PH);
- checks on the correct geo-localization of monitoring stations;
- checks on the consistency of the list of values entered with respect to the list of eligible values (eg, species monitored with respect to the list of species);
- checks on QA / QC in general.

121. Typically, formal controls derive directly from the definitions in the information standard and are easily translatable in automated software procedures. Some consistency checks can be made automated by ad hoc software procedures, while consistency checks on proper geo-localization presupposes the use of GIS software by an operator and are performed manually. These GIS controls will be performed by INFO/RAC personnel. The type of controls and the resulting execution procedures presuppose the existence of a development team devoted to this activity, which also carries out the appropriate form of return on the audit results to the monitoring actors so that they can correct any found errors.

122. In the workflow it is foreseeable that the data transmission and control / validation phase is repeated iteratively until an acceptable level of data quality is obtained.

123. The list of quality control procedures referred to in this paragraph is defined by INFO/RAC.

PHASE IV. Publication and sharing of data

124. The checked and validated, properly aggregated and selected data set must be made publicly available according to the existing Data Policy. The consultation methods are predictable either by means of an analytical search interface (inserting values to be searched in some predefined fields, i.e the name of the monitoring station and / or monitored parameter), or by using a GIS interface with the option of selecting one or multiple station points or areas simultaneously. The system will have to allow the download of selected data through the search as well as its possible sharing via web services to selected community platforms (i.e EMODNET, WISE-Marine, etc.)

3. User Profiles

125. The data processing phases allow you to foresee the following user profile set (each user is characterized by login credentials: username and password):

Administrator

126. It can perform any function available on the system and is responsible for managing users (create / delete users with username and password) for all profiles, including ADMINISTRATOR profile.

Operator

127. It can perform the following functions:

- access and download of information standards and guidelines;
- uploading data in format compliant with information standards;
- access and download of data uploaded to the system;
- access and download of audit data outcomes;

Operator Controls

128. It can perform the following functions:

- access and download of information standards and guidelines;
- uploading data in format compliant with information standards;
- access and download to all data uploaded to the system;
- access and download of data uploaded by his operators to the system;
- implementation of control procedures;
- loading checks on the system;
- access to and download of the results of all data controls;
- access to consolidated data according to the data policy agreed with the Contracting Parties .

Viewer

129. It can perform the following functions on the basis of agreed data policy with the Contracting Parties:

- access and download of information standards and technical guidelines;
- access and download to all data uploaded to the system;
- access and download of audit results for all data.

Public Subject

130. It can perform the following functions:

- access to consolidated data made accessible to everyone.

VI. User Needs Analysis

131. INFO/RAC is performing a user needs analysis of the IMAP monitoring and information system in order to comply with new monitoring requirements.

132. This activity is carried out as follow: bilateral meeting and surveys.

133. Bilateral meetings with RACs, International and Regional Organizations are already scheduled and on planning. A bilateral meeting with REMPEC has been held on 26th May, back to back with the XII Meeting of REMPEC Focal Points.

134. A specific questionnaire format "On-line surveys for Countries: questionnaires as tool to recognize datasets availability to implement IMAP Common Indicators" was developed by INFO/RAC to verify the availability of monitoring data and the fitness for purpose for the IMAP implementation.

135. The questionnaire format (Annex I) has been shared with all the EcAp Task Force and will be further discussed with MAP Components related to the set of the following selected IMAP Common Indicators:

Common Indicator 1: Habitat distributional range (EO1);
Common Indicator 2: Condition of the habitat's typical species and communities (EO1);
Common Indicator 6: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species, particularly invasive, non-indigenous species, notably in risk areas (EO2, in relation to the main vectors and pathways of spreading of such species);
Common Indicator 13: Concentration of key nutrients in water column EO5);
Common Indicator 14: Chlorophyll-a concentration in water column (EO5)
Common Indicator 17: Concentration of key harmful contaminants measured in the relevant matrix (EO9, related to biota, sediment, seawater);
Common Indicator 22: Trends in the amount of litter washed ashore and/or deposited on coastlines (EO10);
Common Indicator 23: Trends in the amount of litter in the water.(EO10)

136. The on-line survey will be addressed to the Contracting Parties and will start tentatively at beginning of September 2017.

VII. Monitoring Information Standards

137. INFO/RAC has implemented a first proposal of the information standards for the collection of monitoring data that are relevant for the implementation of IMAP indicators. Draft data dictionaries are included in information standards and are in line with the provisions of IMAP Common Indicators and data user needs that have been developed and agreed by EcAp working groups (CORMON, CORGES, …).

138. In line with the specific tasks included in the EcAp MED II Project, INFO/RAC is going to implement a "Pilot" Information System that, for its nature, cannot include at this stage all the IMAP Common Indicators. The selection of this sub-set of IMAP indicators (TAB below) has taken into account different elements: the previous experiences in this field, the maturity of monitoring information standards and data dictionaries, their widespread use among Mediterranean Countries, etc. Further Common Indicators can be added or substituted in the group in line with emerging of IMAP pressing needs.

139. The following table illustrates the connection between monitoring information standards and the subset of Selected EcAp Common Indicators:

Table 1.Sub-set of selected IMAP Common Indicators vs related Modules

Ecological Objective	Selected IMAP Common Indicator	INFO-MAP Information Standard
EO1 - Biodiversity	**Common Indicator 1**: Habitat distributional range **Common Indicator 2**: Condition of the habitat's typical species and communities	*Module A* Phytoplankton, Mesozooplankton, Plankton_CD, Macrozooplankton, Macrozooplankton_obs. *Module A1* Habitat coralligenous *Module A2* Maerl *Module A3* Habitat hard seabed
EO2 – Non-indigenous Species	**Common Indicator 6**: Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species, particularly invasive, non-indigenous species, notably in risk areas (in relation to the main vectors and pathways of spreading of such species);	*Module B* Non indigenous species (Phytoplankton, Mesozooplankton)
EO5 – Eutrophication	**Common Indicator 13**: Concentration of key nutrients in water column	*Module C*

	Common Indicator 14: Chlorophyll-a concentration in water column	Physico-chemical parameters *Module C1* Aquaculture plants *Module C2* River plume *Module C3* Urban purification plants
EO9 – Contaminants	**Common Indicator 17**: Concentration of key harmful contaminants measured in the relevant matrix (related to biota, sediment, seawater)	*Module D* Contaminants *Module D1* Contaminants from industrial plants *Module D2* Contaminants from maritime traffic
EO10 – Marine Litter	**Common Indicator 22**: Trends in the amount of litter washed ashore and/or deposited on coastlines	
	Common Indicator 23: Trends in the amount of litter in the water column including microplastics and on the seafloor	*Module E* Stranded wastes *Module F* Microplastics

140. In the Annex II an example of IMAP Common Indicators Standards and Data Dictionaries is provided. (**Common Indicator 14**)

Annex I

“On-line surveys for Countries: questionnaires as tool to recognize datasets availability to implement common indicators” Format

Model On-line surveys for Countries: questionnaires as tool to recognize datasets availability to implement IMAP Common Indicators

Common Indicator number n (EOn)

Title of Common Indicator (for each Indicator of the selected sub-set: 1,2,6,13,14,17,22,23)

Anagraphic section

Data on the entity or organization

(1/1) Name of the organization:

(1/2) Address of the organization:

(1/3) Main activity:

(1/4) Telephone number:

(1/5) Fax number:

(1/6) Email:

(1/7) Website:

(1/8) Type of organization: (put a circle around the suitable answer)

1	Ministry	4	University
2	Governmental organization	5	Public sector
3	Research entity	6	Other

Data on the questionnaire editor

(2/1) Name of the questionnaire editor:

(2/2) Job:

(2/3) Email:

(2/4) Telephone number:

Question 1

Do you have available datasets related to this indicator?

- Yes
- No

If not the case, could you explain why and indicate if in the future you are thinking of collecting data?

If yes, please precise them.

Question 2

Could you indicate the source for each dataset?

Question 3

How those datasets are managed?

- Information system
- Thematic database
- Excel file
- other

Question 4

Could you indicate the data collection frequency and when the last data collection was performed?

Question 5

Could you indicate the methodology used to collect the data (i.e. online form, paper form, etc.)?

Question 6

Are the collected data subject to a quality process?

- Yes
- No

If yes, what type of QA QC is performed?
If not the case, could you explain why?

Question 7

Could you indicate the geographical coverage?

- National
- Coastal region
- Coastal city
- Hydrologic basin
- Other (please specify)

Question 8

Could you indicate time series available for the collected datasets?

Question 9

Could you indicate the data format?

- CSV
- Excel
- XML
- Word
- Html
- Pdf
- Access database (Mysql, Postgresql)
- Shape file
- Other (please specify)

Question 10

Are the data publicly accessible?

- Yes
- No

If yes, how data accessible from an external network?

- Through web services or web API
- Through file transfer (i.e.FTP)
- Other (specify)

If not the case, please specify the reasons.

Question 11

Is the dataset relevant for other national and/or international reporting obligation?

- Yes (specify Plan Bleu, Medpol, NAP, UNSD, etc. other)
- No

Question 12

Is there any specific data policy in place for this datasets?

- Yes (please specify)
- No

Question 13

Are those datasets part of spatial data infrastructure (SDI)?

- Yes (please specify)
- No

Question 14

Are the datasets available also in English or French languages?

- Yes (please specify: English, French or both)
- No (please specify other languages)

Annex II

Model Standards and Data Dictionaries template for IMAP Common Indicators: IMAP Common Indicator 14 as example given

STANDARDS_Stations

FIELD
CountryCode
NationalStationID
NationalStationName
Region
Latitude
Longitude
ClosestCoast
TCMMatrix
SeaDepth
Mixing
AreaTypology
Remarks

STANDARDS_ Physicochemical _parameters

FIELD
CountryCode
NationalStationID
Year
Month
Day
Time
SampleID
Determin_Nutrients
NutrientsSeawater_unit
LOD_LOQ_Flag
Concentration
SampleDepth
Method_Chl-a
Remarks

DATA DICTIONARY _STATIONS

FIELD	DESCRIPTION	LIST OF VALUES
CountryCode	Enter member country code (ie "IT" for Italy)	
NationalStationID	Station code	
NationalStationName	Station name	
Region	Administrative subdivision after country to which the station belongs	
Latitude	Latitude in the WGS84 decimal degrees reference system	
Longitude	Longitude in the WGS84 decimal degrees reference system	
ClosestCoast	Station distance from the coast in km	
TCMMatrix	Measure the environmental matrices in the station, enter one of the values in the list	B = Biota BS = Biota and sediment BSW = Biota, sediment and water column BW = Biota and water column S = Sediment SW = Sediment and water column W = Water column
SeaDepth	Sea depth in meters	
Mixing	Mixing the water column at the station point, enter one of the values in the list	FM = Fully mixed PM = Partially mixed VS = Vertically stratified
AreaTypology	Typology of the monitored area, enter one of the values in the list	HS = Hot spot MPA = Protected Marine Area LTER = Long Term Ecological Research Network O = Other
Remarks	Notes	

DATA DICTIONARY _Physicochemical _parameters

FIELD	DESCRIPTION	LIST OF VALUES
CountryCode	Enter member country code (ie "IT" for Italy)	
NationalStationID	Station code	
Year	Year of sampling in YYYY format	
Month	Month of sampling in 1-12 format	
Day	Day of sampling in 1-31 format	
Time	Hours-minutes-seconds of sampling in HH:MM:SS format	
SampleID	Sample Code if multiple replies are made with the same value as Year, Month, Day and Time	
Determin_Nutrients	Name of the physico-chemical parameter or of the nutrient, enter one of the values in the list in the "List_Physical-chemical"	
NutrientsSeawater_unit	Unit of measurement of the physico-chemical parameter or nutrient, enter one of the values in the list	% = Oxygen saturation M = Secchi disks depth PH = pH ° C = Temperature Mg / l = Chlorophyll a Mmol N / l = Ammonium, Nitrate, Nitrite, Total Nitrogen Mmol O2 / l = Dissolved Oxygen Mmol P / l = Orthophosphates, Total Phosphorus Mmol Si / l = Silicate MS / cm = Electrical Conductivity
LOD_LOQ_Flag	Enter the value '<' in case the concentration value is less than the quantification limit or the value '[' in case the concentration value is less than the detection limit. In the other cases, leave the field empty.	<= Concentration value below the quantification limit [= Concentration value below detection limit

Concentration	Concentration measure	
SampleDepth	Sampling depth in meters	
Method_Chl-a	Analytical method used for Chlorophyll a, Enter one of the values in the list	HPLC Spectrophotometric Fluorometric (Conventional) Fluorometric (Modified, with Narrow Band Pass Filters) Other (Please specify)
Remarks	Notes	

List_PhysicoChemical PARAMETERS

FIELD	DESCRIPTION
Temperature (water)	Water Temperature (° C)
salinity	Salinity
Electrical conductivity	Electrical conductivity (µS / cm)
Dissolved oxygen	Dissolved oxygen (µmol O2 / l)
Oxygen saturation	Dissolved oxygen - saturation percentage (%)
pH	pH
Chlorophyll a	Chlorophyll a (µg / l)
Secchi disk depth	Secchi disk depth (m)
Nitrate	Nitrate (N-NO3 µmol N / l)
Nitrite	Nitrite (N-NO2 µmol N / l)
Ammonium	Ammoniacal nitrogen (N-NH 3 µmol N / l)
Total phosphorus	Total phosphorus (µmoles P / l)
Orthophosphates	Orthophosphates (P-PO4 µmoles P / l)
Total nitrogen	Total nitrogen (µmol N / l)