EEA Data/Information management framework

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Document History

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0.6	July 2015	Stefan Jensen	streamlining and rationalizing
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0.95	2 Nov 2015	Tim Haigh (Beate Werner, Mette Lund, Andy Martin, Nicole Kobosil, Fernanda Nery, Mike Asquith, Eva Ivits)	Comments from consultation across EEA refined and integrated.
0.96		Stefan Jensen (Katja Rosenbohm, Andre Jol)	Final comments integrated and SMT approval.
1		Tim Haigh / Naomi Barmettler	Formatting

Contents

1 Purpose of the document

Data is key for the European Environment Agency (EEA). The EEA relies on data to achieve its outcomes in relation to informing the policy cycle and acting as independent provider of information. Data management activities are carried out across the whole of EEA and a significant amount of resourcing is used on data related activities. This document sets out the principles and framework within which EEA manages environmental information and data assets.

The overall purpose of the document is to support both efficient and effective delivery of the Multi-Annual Work Programme (MAWP) (1), and the adaptation of the EEA to a changing institutional, technological and knowledge environment. The MAWP sets out the overall strategy for EEA. This document sits within the context of the EEA MAWP as a framework for EEA data activities agreed by EEA senior management team. The framework is a guiding structure to support and enable longer term organisational objectives to be achieved. Procedures as part of EEA quality management system underpin this document. They support annual planning and the consistent and effective implementation of EEA's data management policy in the day-to-day operations.

Whilst the document has a role as a repository and reference for EEA organisational practice, it has also been designed with a view to offer insight for newcomers to EEA data activities as well as stakeholders providing data to or making use of data from EEA. It is complemented and supported by more detailed procedures and business processes. The document is intended to be updated at least once within each MAWP cycle.

1.1 Setting the scene

The Regulation (2) setting up the European Environment Agency sets out a primary objective for the EEA to provide technical and scientific support in order to provide objective, reliable and comparable environmental information at European level. The purpose of the information is to enable Member States and the European Community to take measures to protect the environment, to assess the results of such measures and to ensure that the public is properly informed about the state of the environment

The Regulation further sets out that the EEA is responsible for the collection, processing and analysis of data and outlines the principal areas of activity of the EEA to include all the elements enabling it to gather the information making it possible to describe the present and foreseeable state of the environment and placing this in the context of sustainable development.

The 7th Environment Action Programme (3) guides European environment policy until 2020 and sets out priority objectives (PO) which include one (PO5) aiming**: "**To improve the knowledge and evidence base for Union environment policy." Specific actions in the 7th EAP PO5 are identified, such as "simplifying, streamlining and modernising environmental and climate change data and information collection, management".

European Institutions are emphasizing a more evidence based policymaking approach which creates an increasing demand for high-quality data. The European Commission relies on a

hybrid of forms for data collection and processing from EEA, Eurostat, JRC, and also contracted-out data collection and processing activities.

1.2 The data, information and knowledge chain

The scope of this document is focussed on 'data' as such. Probably the most prominent approaches to defining data is to contrast them with the concepts of information and knowledge to create a chain D- Data, I – Information, K – Knowledge, W – Wisdom (4)). This model has been subsequently refined, and adapted to fit within EEA's context.

The EEA has extended this concept to include "monitoring" (the "M") or "observations" that create the data. In addition EEA has added assessment in the sequence.

To help specify and distinguish between the different types of information needed in particular for countries to report on in order to support the policy process) the EEA uses the MDIAK framework specifying, in reverse order:

- What do we need to Know (K)?
- What Assessments are needed (A)?
- What Indicators are needed (I)?
- What Data is needed (D)?
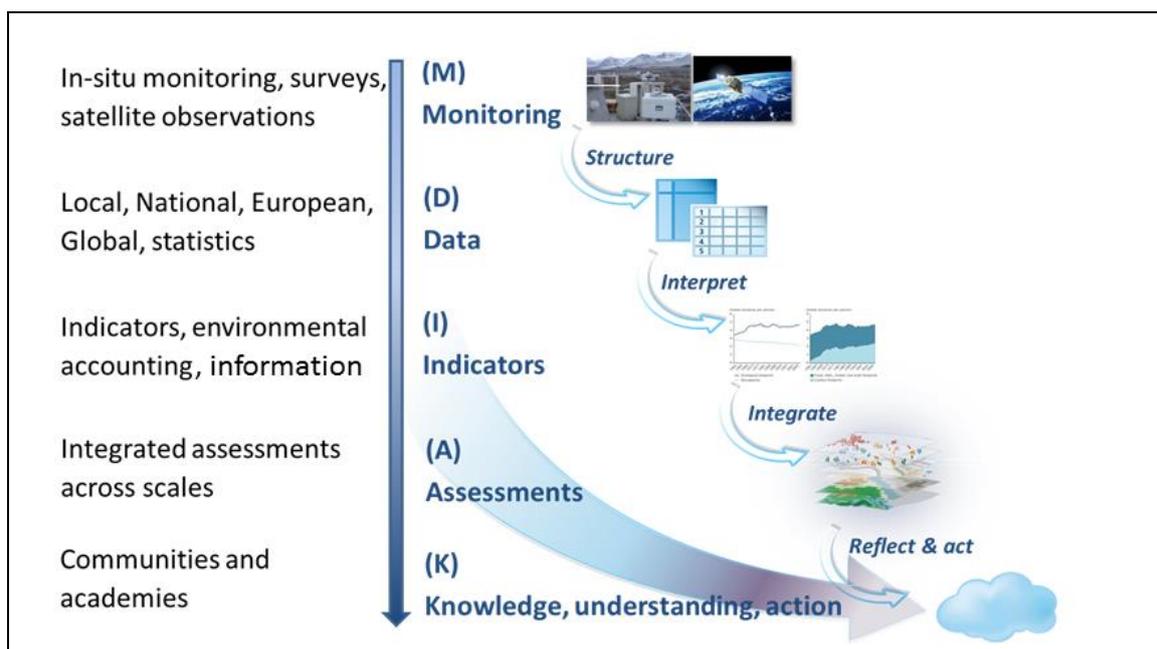- What Monitoring is needed to deliver the required data (M)?

Figure 1.2: Knowledge management at the EEA

Data management focuses on D in MDIAK including also processing D from M activities (such as Copernicus) and preparing D for creation of I and eventually the creation of Knowledge (K). EEA does not usually control Monitoring (M) activities, but is dependent on them.

Thus, the MDIAK framework drives data management in the organisation and supports implementation of European policy goals through a wide variety of data activities, including:

- Creating European datasets (i.e. for trans-boundary topics)

- Creating and updating multiannual time series
- Creating information products (graphs, maps, infographics, websites, etc.)
- Validating and supporting expert opinions and assessments
- Supporting the creation of evidence to explain causality
- Supporting public engagement in environmental decision making through improved understanding and an exploration of the local to European context.

2 Vision statement and overall objective

2.1 Vision

- EEA is both a user and provider of environmental data. EEA acquires, processes, publishes and preserves European environmental data.
- Data management is crucial for EEA to create quality assured environmental data and information products as part of the evidence base in support of decision making in the policy cycle.
- EEA advocates full open and free access to environmental data, and makes its own data freely available for all.

2.2 Objective of EEA data/information management framework

The overall objective is to comply with the EEA Regulation and to enable both efficient and effective delivery of the Multi-Annual Work Programme. In doing this, the aims of the EEA data/information management framework are to:

- Create and use relevant, accurate, timely, accessible, compatible and coherent data;
- Ensure work on data is aligned with EEA business needs and priorities;
- Enable a consistent and effective implementation of EEA's data policy in day to day operations;
- Improve allocation of resources for data and information management activities in order to reach EEA goals;
- Identify and exploit efficiency gains and eliminating unnecessary differences in approaches by thematic areas;
- better support integrated assessments, by harmonisation of data management approaches as well as basic data, like spatial reference data;
- Stream-line and incentivize individual approaches to become generally deployed best practice across the organisation;
- Leverage other relevant initiatives, including, GEO data sharing and management principles (5), INSPIRE (6), SEIS (7) and the Generic Statistical Business Process Model (GSBPM) (8).

3 Stakeholders

The EEA stakeholder map includes a wide variety of stakeholders most of whom are relevant to EEA data activities either from a user or provider perspective and sometimes both.

Data provision to EEA can be broadly categorised into four types: provided by member countries in Eionet, procured and provided by other EU or international organisations, such as Eurostat, OECD, UN specialised agencies or research projects.

From a data management perspective, EEA stakeholders which are providers or users need to
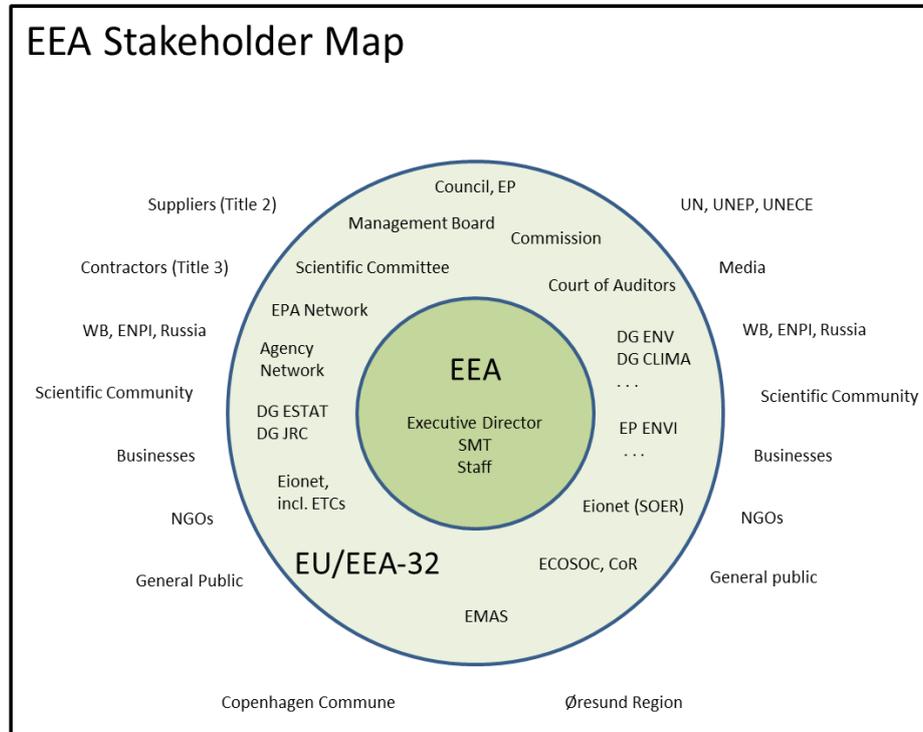

Figure 3.2 EEA stakeholder Map

in particular be aware about data quality, standards, and architecture aspects related to data delivery and publication. Descriptions of relationships to EEA stakeholders are set out in the EFQM book of evidence, (9) as part of EEA Quality Management System. EEA stakeholders and partners need to have clearly defined, and, where necessary, regulated access to data sets and applications.

4   Resource allocation

EEA uses a substantial part of its budget and personnel resources to manage data as well as developing and maintain IT tools for that purpose.

The EEA work programme results in production of thematic data sets especially under Strategic action 1 with two thematic programmes extensively involved (ACC and NSS). EEA works with European Topic Centres and other consultants to process, integrate and quality assure data in order to compile European data sets. The work is increasingly standardised and executed in a specific architectural setting.

Around half of the EEA staff resources with responsibility for data management activities are centralised in a horizontal support programme (IDM) and the other half managed in thematic programmes. Data managers in the thematic areas cooperate with IDM, within clearly defined roles. Much of the basis for this interaction is set out in the data quality framework or related

procedures. The horizontal support in IDM processes and quality assures data products prior to publication. This group also maintains the EEA data processing system and guides the work of thematic groups.

More than half of the operational costs (7.9 M Euro in 2015) is allocated to grant agreements with the six European Topic Centres, of which approximately half is used for data management. Approximately 1M Euro per year is used for development of IT tools for supporting management of data. EEA data management activities rely on production of observations (monitoring) the cost of which is not covered by EEA and is bourn upstream of EEA.

The data management framework is key to frame workflows and business processes across EEA in particular between IDM, thematic programmes and ETCs.

There are also data users who are affected by data access arrangements under the EEA data policy but who are not involved in data production activities covered by the data management framework. Through its objectives and roadmap the data management framework enables a more structured approach to taking user expectations into consideration, in particular to enable notification of updated availability of data and access to rearrange views and explore multipurpose European data, both environmental and relevant socio economic sources.

The quality management group EDO1 maintains oversight over improvement processes connected to the data and information management framework and coordinates the implementation of it.

5 Core principles

The EEA environmental Data Management Framework follows a set of principles to improve efficiency and effectiveness and to underpin the EEA data policy (10).

EEA data management principles

- Transparency - Full, free and open access to data and their QC procedures.
- Usability - data can be used to create information products and services.
- Traceability – data has known provenance and outputs can be connected to data sources.
- Coverage - data covers areas of interest, usually multiple countries.
- Availability - data is stored and accessible.
- Repeatability - known methods applied to the data.
- Sustainability - data are updated to document trends.
- Re-usability - data can be re-used internally or externally (including by the public).
- Uniformity/comparability - similarity of data from different geographical, thematic or institutional sources.

The following sections expand on the principles listed above.

5.1 Full and open access

The EEA data policy lays the ground by addressing access to and redistribution of EEA data and products. They are considered public goods and shall be made available with minimum time delay and no cost with a few exceptions acknowledged.

5.2 Ease of use and re-use

EEA data shall be easily and broadly usable. Technical means shall assure easy discovery, viewing and – as far as possible - downloading. For that purpose, latest information technologies which need to be compliant with established standards shall be utilised.

Recognition of data sources including data from Member Country (Eionet) reporting, crowd-sourcing or citizen science will be provided with the data or as disclaimers in the corresponding services. Traceability e.g. up and downwards the abovementioned MDIAK chain and thus access to the source is provided where possible.

5.3 Data and Information quality

At defined instances in all steps of the data and information workflow, quality assessment (QA) and quality control (QC) shall be performed following domain-based and other standards. This workflow is framed by the MDIAK (Monitoring – Data – Information – Assessment – Knowledge) chain which is one core model for EEA data and information management. The various elements of the quality management are documented in complementary papers.

The separate *Data quality framework* covers all important data quality aspects, it treats metadata in a separate chapter.

After a reorganisation in January 2015 the group dealing with general quality management has been put directly under the Executive Director to heighten awareness for quality throughout the Agency.

6 Data management and governance

Data governance defines decision making processes and measures to oversee data management. Data governance in this context ensures that data is managed in a controlled manner.

Data governance is a key element for maintaining and improving data quality, it has strong links to organisational structure and process design and roles. In some EEA documents the term data management embraces data governance.

EEA data management including its governance is undertaken by a set of different groups which all need to incorporate the common Data Management Framework while having different roles. Data management governance structures might also include roles of external stakeholders like the ETCs, or the European Commission with whom standard arrangements can be put into place for co-created products.

6.1 Reference frameworks

Through the establishment of the data and information management framework EEA has decided to base its data management on current international frameworks and standards. No single reference framework can be applied in its entirety to the EEA organisational model and MDIAK chain. The EEA framework is adapted from Cobit5 (11), DAMA (12) and Data Management Maturity Model DMM (14) as well as applied frameworks used by other organisations.

Data quality is in particular addressed through the implementation of the provisions in the INSPIRE directive (6) and the European Statistics Code of Practice (13) and UN framework on environmental statistics (14) and the Generic Statistical Business Process Model (GSBPM) (8)

EEA makes use of the following standards for metadata: ISO 19115 and ISO19139.

To effectively implement these frameworks at EEA, performance indicators are identified as part of EEA multi-annual planning and training and awareness raising has been initiated and is planned to continue. Through the implementation of the data and information management framework the data acquisition, processing and publication will be stepwise adjusted to conform to best practice and benefit from these reference frameworks.

6.2 Procedures

The Data/Information Management Framework and the Data Quality Framework set the overall direction and approach for data activities in MDIAK chain to create information. Procedures set out specific methods describing how frameworks and policies, including EEA's data policy, will be put into action in day-to-day operations. Procedures can be documentation of workflows or business processes or quality assurance tasks, etc.

Procedures are included in the overall EEA Quality Management System. Procedures are structured according to inputs (acquisition), processing activities and output (publication). Data governance sets out how these procedures are agreed to and also includes monitoring and optimising of the governance measures. Procedures are reviewed by their owners, often those undertaking or organising the tasks. Changes to procedures are approved by those in line management or in beneficiary type roles (ie those for whom the work is being done within EEA). Updated versions are discoverable through the Quality Management Systems on Intranet. Procedures include information on:

- Who will do what (roles)
- What steps they need to take (tasks, approvals, decisions)
- Which forms, systems or documents to use.
- Who owns, maintains and who approves the procedure.

New data flows and data activities are implemented according to existing procedures or build on existing procedures.

6.3 Risk and security

Risk management is an integrated part of managment in the EEA and is part of the annual management planning system. The Internal Audit Capability and Internal Control Standards define the risk management approach. Data and IT related risks are identified and evaluated in

the project approval process of the IT Steering Committee. Risks are management through project management during implementation. When new, unexpected risks occur, they can be flagged up to line management.

A section in the ICT strategy covers security was drafted and a new function for information and data security is to be established and ensuring that EEA follows best practice in relation to data protection of individuals (Regulation (EC) 45/2001), on the protection of databases (Directive 1996/9/EC), as well as on data access (Directive 2003/4/EC) and re-use (Directive 2003/98/EC). The programme responsible for ICT ensures that there is appropriate security assurance in place for sensitive data.

6.4 Change management

EEA has organised the IT related groups in one department (Programme IDM) to implement a clearer enterprise wide governance of data. Data related roles are now better defined. The establishment of a quality management group directly under the Executive Director strengthens the overall awareness and compliance with quality management and governance. The existing Quality Management System, based on ISO 9001, is currently under review to make it more effective. It is now been complemented by further important frameworks for data, IT and quality. Updated and unified overviews of systems, projects and data flows are now available.

Training in data governance is actively supported by Head of Groups and Programmes. Training on data reporting in the EIONET is well established. EDO is in lead in introducing the Management Frameworks and overseeing the continuous improvement process which will be implemented across the organisation, but in particular in IDM. Changes in practices or technology need to be reflected in the Data/Information Management Framework which will be updated as needed.

7 Architecture

The EEA architecture is built to support typical data and information flows as displayed below.

Key elements of the EEA architecture for data management are Reportnet as the data acquisition system, the common workspace to process national data into European data sets and the EEA data warehouse from which data and data related products are been published. Data contributing to indicators are prepared within the indicator management system (IMS). These building blocks are underpinned by a spatial data infrastructure, by the increased use of cloud computing services which are further described in the ICT strategy.

A key concept is to avoid building new or specific solutions from scratch because this does not enable the EEA to leverage past investments or existing resources. For data publication, EEA uses a limited number of standardised software tools, and publishes own web services as well as information platforms owned by Commission services. EEA currently hosts and maintains an increasing number of thematic websites (e.g. WISE, BISE, ePRTR, ClimateADAPT, Copernicus land) on behalf of several Commission services (ENV, CLIMA, REGIO, MARE, GROW). Over time, these websites and their content need to be brought stepwise into alignment with EEA architecture and structured approaches to agreement on service levels and ownership put in place.
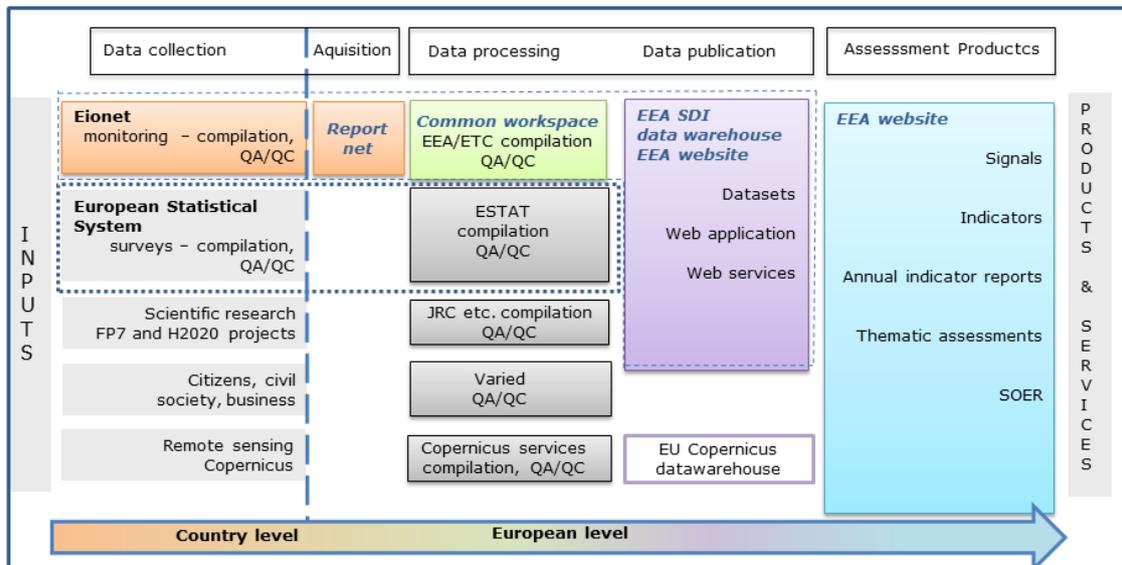
Figure 7.1 Highlighted architecture components of data/information management at EEA

The available software resources are managed in IDM. The Reportnet open source suite of tools is developed by EEA to support data acquisition. Management of spatial data is mostly done using tools from ESRI, metadata through GeoNetwork. Preparation of data for use in assessments and other derived products is often performed by use of MS Excel and Access. The common workspace (under development) is the centralised platform to enable data processing and product preparation activities by EEA staff, ETCs and consultants. The EEA web site uses ArcGIS-based map viewers and the PLONE content management system to provide products and data services.

8 Data life cycle

Data management activities are carried out across the whole of EEA. The data life cycle follows the universal input – output process model. The process improvement feedback loop is strengthened through data management activities. EEA systems, procedures and infrastructures provide key underpinning elements necessary to achieve data and information management EEA goals.

The data life cycle can be divided into three parts: A planning phase; data management and thirdly data usage. This document and implementation of the data and information management framework focuses on activities in the data management part.

The further implementation, guidance and training for thematic data experts and ETCs will be structured along the elements outlined in this data life cycle.

Data lifecycle	Planning	Requirement analysis
		Component identification
		Content specification
		Data availability audit
		Data source identification
		Development
	Data management	**Acquisition (input)**
		Processing
		Quality control
		Documentation & Cataloguing
		Publication (output)
		Preservation / archiving
	Usage	Analysis
		Value added product creation
		Dissemination
		Usage tracking
		User feedback
		Citation
		Gap analysis

Table 8.1 Data lifecycle

8.1 Acquisition

EEA acquires data from numerous sources: EEA can procure data; obtain data from countries through Eionet or other data acquisition organisational networks (Eurostat, OECD, EC, UN conventions (UNECE) or UN specialised agencies (WMO)) , make use of research data (such as FP projects) or establish specific agreements with data suppliers (countries or businesses).

The decision on how to obtain the data and how to carry out data handling is often driven by consideration of the balance between benefits to EEA, capability (technical resources, experience and expertise) and costs of having in house competencies versus outsourcing.

By far the largest part of data acquired by EEA is secondary acquisition that is obtained through an intermediary (e.g. such as Member States) or obtained from organisations that have already used the data to fulfil their own mandates (E.g. Eurostat).

A key rationale is that secondary data acquisition is cheaper, less risky and imposes a lower burden on providers. A limitation of secondary data acquisition is that EEA has less influence on whether its requirements are met and must continuously manage the organisational dependencies established with stakeholders. Also data may enter the EEA MDIAK framework when it is close to the "I" in status, with limited traceability and relatively disconnected from the original sources or monitoring.

EEA has structured much of its work on secondary data acquisition around the concept of priority data flows. Data in priority data flows is acquired from submissions through Eionet, with NFPs and sometimes ETCs acting as agents of EEA. By definition, priority data flows contribute to regular EEA information products and were developed to respond to information or indicator requirements that were, in turn, developed to respond to policy questions. The priority data flows are regularly reviewed and evolve as is the balance of approaches used to acquire data in response to evolving stakeholder relations and policy demands.

Alongside priority data flows, EEA also and made use of other secondary data sources for data acquisition. This approach of using secondary data acquired through sources other than the Eionet is growing. Increasingly, the EEA also organises and supports reporting for legislative data flows [under article 2c of EEA regulation] from Member States to the EU on behalf of the Commission where specific thematic directives and horizontal processes are important in setting requirements on data management.

A small and also growing part of data acquired by EEA is primary data, i.e. data which EEA obtains directly from data providers (businesses and citizens).

In late 2014 EEA established an EEA/NFP working group to review of the Eionet priority data flows. The review proposed a new set of data flows, referred to as Eionet (country) core data flows to ensure the ongoing alignment of the Eionet core data flows with the needs deriving from the MAWP 2014-2018 and the 7th EAP. With the current proposal of Eionet country core data flows, some of these data would be included into EEA data and information management with a high priority, depending on the relationship to EEA products.

The legacy of choices in data acquisition has important and pervasive impacts on subsequent stages of the data life cycle.

8.2   Data processing

Data processing includes all the necessary steps to transform acquired data into useable datasets and to prepare the suite of routine data products. Data processing activities are undertaken in both in-house (centralised or decentralised structures) as well as being outsourced, such as to ETCs or contractors.

8.3   Data quality control

EEA data should be of known quality. Criteria in relation to timelines, completeness and coherence are set out for Eionet data flows. QC and QA take place at numerous instances in the dataflow, for instance in countries, on submission to EEA, during processing operations and prior to publication. All QA and QC checks are carried out on Eionet data flows are publically described as well as the results of the checks, which are included in the data documentation. Data that have not completed QC routines are flagged as preliminary.

The separate Data Quality Framework covers all important data quality aspects, key references are below.

8.4   Documentation and cataloguing

Data documentation provides information about the dataset and is included in meta-information. Meta data follows international standards by including a description of the

dataset as well as information on its source, temporal and spatial coverage, property rights and responsible parties.

Cataloguing is undertaken to enable discovery. Cataloguing makes use of dataset metadata to publish the data in a useable way. EEA contributes with catalogues to the GEOSS portal and the EU INSPIRE geoportal to ensure that European datasets are discoverable more broadly and contribute to international initiatives, such as GEO, UNGGIM and UN bodies.

8.5   Publication

EEA publishes data that appear in data products, and aims to also provide the underpinning datasets. Data is published in a wide variety of formats and products, including in web applications (such as map viewers), web services, datasets, reports and indicators as part of the EEA website. Promoting data products and timely updating is needed to maximise value from data acquisition and processing activities.

8.6   Preservation and archiving

EEA collects data from its Member Countries through the Eionet and has responsibility for safeguarding this collection process including long-term preservation of the data and archiving of methods applied to the data. This needs appropriate documentation and a capable IT based storage and security system. The documentation needs to include the way data are processed and quality assured.

EEA has a clear approach to preservation which is focused on data which EEA exclusively holds or has used in creation of data products. Key repositories of data are:

- Reportnet for national deliveries;
- The spatial data infrastructure for geospatial European-wide data sets;
- The EEA data service - for tabular European wide datasets;
- Near real time data (preliminary) is stored until replaced by validated new data submissions;
- The Indicator Management System preserves historic versions of Indicators and references to the data used.

The growing complexity of data dependencies and use of digitized data in final products will require a more sophisticated approach to be designed in the future.

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8.6.1.1.1 Annex 1: Definitions - UN framework for development of environmental statistics (14)

Environmental data are large amounts of unprocessed observations and measurements about the environment and related processes, collected or compiled by statistical surveys (censuses or sample surveys) by the national statistical systems, or originated from administrative records, registers, inventories, monitoring networks, remote sensing, scientific research, and field studies.

Environmental data are processed into **environment statistics** that describe, aggregate, synthesize and structure environmental and other data according to statistical methods, standards and procedures. Not all environmental data are used in the production of environment statistics: the FDES provides a framework that identifies environmental data that fall within its scope and then contributes to structuring, synthesizing and aggregating the data into statistical series and indicators.

Given that environment statistics are usually too numerous and detailed to satisfy the needs of policy makers and the general public, they often require further processing and interpretation, resulting in **environmental indicators**, i.e. measures that summarize, simplify and communicate information. Environmental indicators define objectives, assess present and future direction with respect to goals and values, evaluate specific programmes, demonstrate progress, measure changes in a specific condition or situation over time, determine impact of programmes and convey messages. Frameworks such as the DPSIR or policy frameworks such as the MDGs or the SDIs are typically used for the identification and structuring of indicators.

Environmental indices are composite or more complex measures that combine and synthesize more than one indicator or statistic that are weighted according to different methods. An index can provide a valuable summary measure for communicating important messages in a popular way and thus raising awareness; however, they often raise questions related to their proper interpretation, methodological soundness, the subjectivity of weighting and the quality of the underlying statistics.

For specific analytical purposes, environment statistics may be organized and structured according to different **analytical frameworks** such as for instance the DPSIR framework, or issue-based frameworks which focus on specific environmental problems (e.g. climate change, air pollution, etc.); policy-based frameworks such as sustainable development strategies, or assessment frameworks such as those used in state of the environment reports. **Accounting frameworks**, such as the SEEA, reorganize the relevant environment statistics according to stocks and flows within and between the environment and the economy based on national accounting principles, thus linking environment statistics with the System of National Accounts and facilitating the analysis of relationships between the economy and the environment.

These types of environment statistics are all important and interdependent. They all feed back into each other to produce diverse and complementary products that can be used for different purposes and that fit specific user needs and resources of countries or agencies. Ideally, information about the environment can be produced and used as an integrated system which would increase synergy and consistency, as well as efficiency in the use of limited financial resources.

Geographically referenced information that includes digital maps, satellite and aerial imagery, and other sources of data that are linked to a location or a map feature, all structured in databases, will also add significantly to the quantity and quality of information that is organized within the context of environment statistics. GIS can be viewed as an integrating technology that helps to capture, manage, analyse, distribute and use a wide range of data with a spatial or locational component.