

Draft updated Recommendations on Electronic Information Tools

The Meeting of the Parties recommends to Parties, Signatories and other interested States to undertake the following measures:

I. PURPOSE

1. The Recommendations aim to assist Parties, Signatories and other interested States in the promotion of promoting development, maintenance, update and use of electronic information tools to support the implementation of the Convention by applying common approaches and standards;
2. For the purposes of these Recommendations, supporting explanatory notes on terms and approaches are provided in Annex;

II. GENERAL POLICY

3. Develop and adopt national/state strategies aimed at promoting electronic tools to facilitate administrative processes and services relevant for assisting the public to exercise their rights in accordance with the Convention, such as “e-government”, “open government”, “open data” and “digital transformation”;
4. Take the necessary legislative, regulatory, institutional, practical and other measures to implement the above strategies as to make public administration more transparent and efficient in: providing environmental information and dealing with requests for such information from the public; facilitating public participation in decision-making; and assisting the public to seek access to justice;
5. While applying the above measures, take into account the cross-cutting nature and comprehensive scope of environmental information, its linkages with geospatial, statistical, meteorological, health, Earth observation and other relevant information whilst promoting interoperability and sharing between the respective information systems guided by best available international standards (see also sections III and IV and Annex);
6. Develop where missing, continuously maintain and update nationwide digital environmental information systems using best available state-of-the-art digital technologies in accordance with the approach of ‘open by design and by default’ (see also section IV and Annex). The system should be well structured to inform evidence-based decision-making and policy development relating to environmental matters; support measuring and reporting progress towards the achievement of internationally and national/state agreed goals and targets related to environmental matters; identify emerging environmental risks and vulnerabilities, support multi-hazard early warning system and promote environmental awareness among the public and other stakeholders;
7. Take the necessary measures to reduce and remove social, financial and technological barriers restricting public access to environmental information through telecommunications networks, such as high connection costs and poor connectivity, and lack of computer literacy. Enhance the inclusive use of digital technology and electronic information tools ~~as~~ to promote exercising rights in accordance with the Convention by groups and communities in vulnerable situations, such as ~~such as~~ children, older people, women in some societies, migrants, people with disabilities, those with low literacy or language barriers, ethnic or religious minorities, economically disadvantaged groups, those without access to the Internet, television or radio, etc.¹¹

¹¹ See also Resolution 20/8 on the promotion, protection and enjoyment of human rights on the Internet adopted by the Human Rights Council on 16 July 2012 (A/HRC/RES/23/2) and available at: https://ap.ohchr.org/documents/dpage_e.aspx?si=A/HRC/RES/20/8; Resolution 31/32 on protecting human rights defenders, whether individuals, groups or organs of society, addressing economic, social and cultural rights, adopted

8. Promote and use electronic information tools to facilitate public input to and monitoring of decision-making in environmental matters, among other things to:

- (a) Alert the public to ~~respective~~ opportunities **for participation**;
- (b) Ensure that the public can provide publicly documented feedback on proposed activities, plans, programmes, policies and legally binding instruments electronically; and
- (c) Ensure that submissions received electronically are given equal weight to comments received non-electronically;

9. Ensure the resource mobilization and sufficient allocation of resources to develop, continuously maintain and update electronic information tools to support the implementation of the Convention using best available state-of-the-art digital technologies. Use the gains from a reduction in the administrative burden of public authorities, especially from processing information requests, and the associated cost savings from improved efficiency to contribute to the resource mobilization;

10. Promote and contribute to international policy dialogue on the use of electronic information tools to promote public access to environmental information and public participation in decision-making in environmental matters through the exchange of experience, documentation and sharing of best practice, the transfer of know-how and the provision of technical assistance;

11. Establish and, in the case of donor countries, international financial institutions and other partner organizations, provide financial and technological support for schemes for the transfer of technology and expertise so as to overcome or reduce the 'digital divide' and all aspects related therewith, e.g. through bi- and multi-lateral projects or partnerships, and promote digital inclusion, especially in remote areas, and gender equality;

12. Base the provision of environmental information on ~~the assessment of~~ user needs, monitor the form and content of the information provided in relation to user needs, and assess the impact of the information delivered, in order to raise environmental awareness and facilitate active engagement;

13. Ensure that mandatory systems established to provide an adequate flow of information to public authorities about proposed and existing activities which may significantly affect the environment are continuously maintained and updated using best available state-of-the-art digital technologies and international interoperability and other standards;¹²

14. Encourage the integration of "big data", including but not limited to remote-sensing data, and data from other sources, as appropriate, into nationwide digital environmental information system to facilitate timeliness, openness, and spatial-temporal coverage of data, and its cost-efficiency, usefulness for discovering trends, reanalysis, forecasts, projections, and for cross-thematic analysis;

15. Support and use "Open Science" and "open research data" initiatives to inform environmental policy-making and facilitate transparent public discussions;

16. Promote through electronic information tools the use of citizen science, crowdsourcing and local and indigenous knowledge to support performance of public functions or provision of public services related to environmental monitoring and to promote environmental awareness among the public (see section V);

on 24 March 2016 and available at https://ap.ohchr.org/documents/dpage_e.aspx?si=A/HRC/RES/31/32; Maastricht Recommendations on Promoting Effective Public Participation in Decision-making in Environmental Matters (see document ECE/MP.PP/2014/2/Add.2), para. 20, available at <http://www.unecce.org/index.php?id=49142>

¹² The Aarhus Convention, article 5, paragraph 1 (b).

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17. Provide information in the national language(s) and at least basic information of interest to the international community in English;

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18. Document good practices related to the application of the Convention at national/state and local levels in areas outlined in paragraph 20 below, and share information on these through the Convention's clearing-house mechanism and the national nodes¹³;

19. Provide information on the implementation of these Recommendations and the obstacles encountered through the Convention's national implementation reports¹⁴;

III. PRIORITY CATEGORIES OF INFORMATION

20. Ensure, where necessary through introducing appropriate legislative or regulatory measures, that, subject to the provisions of article 4, paragraphs 3 and 4, of the Convention:

(a) Public access to environmental information is provided in electronic form and published through the internet, so that information required to be publicly available under the Convention is required to be provided in electronic form where so requested and where the information exists in that form or can reasonably be put in that form;

(b) Documentation which is required to be drawn up and/or submitted in the context of decision-making in environmental matters that is ~~are~~ subject to the provisions of articles 6, 7 and 8 of the Convention is required to be provided in electronic form and progressively through the Internet;

(c) Nationwide digital environmental information system supports public access to real-time, as appropriate, and other dynamic, up-to-date, accurate and quality-controlled, comprehensive, standardized and functional environmental information and this information is made discoverable and accessible in forms and formats meeting the needs of different users through the internet;

(d) ~~In line with identified user needs,~~ The following types of information are required to be progressively become publicly accessible, in a timely manner, through the Internet, preferably through one-stop access point(s):

- (i) Reports on the state of the environment¹⁵;
- (ii) Texts of legislation, regulations, rules and other legally binding instruments on or relating to the environment and their drafts¹⁶, including court decisions;
- (iii) Texts of policies, plans and programmes on or relating to the environment, and environmental agreements¹⁷;
- (iv) International treaties, conventions and agreements on environmental issues, decisions and reports relevant to their implementation and compliance at the national/state level¹⁸;

¹³ Decision II/3, paragraph 2, adopted by the Meeting of the Parties to the Convention (document ECE/MP.PP/2005/2/Add.4) , available at: <http://www.unece.org/env/pp/mop2/mop2.doc.html>;

¹⁴ See reporting format (questions XI-XIV) endorsed through decision IV/4 of the Meeting of the Parties to the Convention (document ECE/MP.PP/2011/2/Add.1), available at: <http://www.unece.org/env/pp/reports.html>

¹⁵ The Aarhus Convention, article 5, paragraphs 3 (a) and 4.

¹⁶ The Aarhus Convention, article 5, paragraphs 3 (b) and 5 (a), and article 8, second sentence, paragraph (b).

¹⁷ The Aarhus Convention, article 5, paragraphs 3 (c) and 5 (a).

¹⁸ The Aarhus Convention, article 5, paragraphs 5 (b) and (c); the Almaty Guidelines on Promoting the Application of the Principles of the Aarhus Convention in International Forums adopted through decision II/4 of the Meeting of the Parties to the Convention (document ECE/MP.PP/2005/2/Add.5) available at: http://www.unece.org/env/pp/aarhus/almaty_guidelines.html

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- (v) Data on ~~environmentally significant~~ releases and transfers of pollutants, within the scope of the Protocol on Pollutant Release and Transfer Registers¹⁹ or for which there is a legal obligation to report;
- (vi) Documentation forming an integral part of any environmental impact assessments, state ecological expertise, licensing or permitting process subject to the provisions of article 6 of the Convention (e.g. public notices, applications, risk assessment and other studies, all other relevant documentation, comments of third parties, draft and final decisions and attached conditions) where it is held in or can easily be converted into electronic form ~~or, where it is not available in such form, a reference to where such documentation can be accessed~~²⁰;
- (vii) Documentation forming an integral part of strategic environmental assessment or other processes of ~~preparing~~ ~~preparations~~ plans, programmes, policies relating to the environment subject to the provisions of article 7 of the Convention (e.g. public notices, all other relevant documentation, including risk assessment and other studies, economic analysis and assumptions, comments of third parties, draft and final decisions) where it is held or can reasonably be converted into electronic form ~~or, where it is not available in such form, a reference to where such documentation can be accessed~~²¹;
- (viii) All information which could enable the public to take measures to prevent or mitigate harm arising from an imminent threat to human health or the environment, whether caused by human activities or due to natural causes²²;
- (ix) Information on mechanisms related to access to justice, and decisions of courts and other review bodies to support the implementation of article 9 of the Convention²³;

~~(e) To the extent feasible and appropriate and in line with identified user needs, information of types such as the following progressively becomes publicly accessible, in a timely manner, through the Internet, preferably through one stop access point:~~

Commented [FC2]: Sub-paragraphs (d) and (e) should be merged.

- ~~(ix)~~ Environmental monitoring data²⁴ held by or on behalf of public authorities or crowdsourced, including dynamic and other data with spatial attributes regarding quality and pollution of air and of water in major watercourses, water reservoirs and sources of other surface and underground water;
- ~~(xii)~~ Other information about the state of the elements of the environment and factors such as big data or space-based data, electronic databases, registers, cadastres and inventories²⁵;
- ~~(xiii)~~ Eco-labelling and eco-auditing schemes, “product passports” and other environment-related product information that enables consumers to make informed environmental choices²⁶, cooperation with the private sector being essential in ensuring provision of this information; Harmonised digital information systems integrating product specific data such as those on material and energy efficiency, toxicity, material composition, durability, repairability and recycling to enable consumers as well as other actors in value chains (e.g. market surveillance and waste management) to improve their environmental performance.²⁷ Examples include product databases, digital product passports, ecolabel and eco-auditing schemes, and environmental product declarations (EPDs);
- ~~(xiiiiv)~~ Good practice information and guidelines on better environmental management, sustainable consumption and production, best available techniques, green procurement, green and circular economy and sustainable development²⁸;

¹⁹ The Aarhus Convention, article 5, paragraph 9; the Protocol on Pollutant Release and Transfer Registers, done at Kyiv on 21 May 2003.

²⁰ The Aarhus Convention, article 6 and article 5, paragraph 3(d).

²¹ The Aarhus Convention, article 7 and article 5, paragraph 3(d).

²² The Aarhus Convention, article 5, paragraph 1 (c).

²³ The Aarhus Convention, article 9, paragraphs 4 and 5.

²⁴ The Aarhus Convention, article 5, paragraphs 2 (b) and (c), 3 (d), 7 (a) and 9.

²⁵ The Aarhus Convention, article 5, paragraph 2 (b) and (c), 3 (d), 7 (a) and 9.

²⁶ The Aarhus Convention, article 5, paragraphs 6 and 8.

²⁷ The Aarhus Convention, article 5, paragraphs 6 and 8.

²⁸ The Aarhus Convention, article 5, paragraph 7 (b).

(xiv) Environmental monitoring and other information supplied to the public authority by a third party being under legal obligation to do so in accordance with the national/state framework²⁹;

(xv) Information on environmental enforcement and compliance³⁰;

(vi) Funded environmental projects, other information on the performance of public functions or provision of public services relating to the environment by government at all levels³¹;

(xvii) Standardized metadata so that the data source, date of its production and update, restrictions, production, verification and validation methods, processes, and legal obligations, and context of data and information collection and management are transparent, allow data mining, machine to machine communication, use and re-use (see also Annex, section IV)³²;

(xviii) Meta-information, including catalogues of data sources and details of the scope of information held by public authorities and mechanisms for the provision of access to environmental information³³;

(f) The report on the state of the environment³⁴ to be published and disseminated in accordance with the Convention should include information on the quality of the environment and information on the pressures on the environment. The report should be based on the relevant indicators of Sustainable Development Goals, ECE and other internationally agreed and national/state environmental indicators and provide access to underlying datasets from pollutant release and transfer register and other sources, as appropriate. The report should be prepared through a consultation process with members of the public and other stakeholders in accordance with the national/state framework and good practices;

(g) The use and re-use of environmental information should not be subject to conditions. However, in some cases justified by a public interest objective, a licence may be issued imposing conditions on the re-use by the licensee dealing with issues such as liability, the protection of personal data, the proper use of documents, guaranteeing non-alteration and the acknowledgement of source. If public authorities license environmental information for re-use, the licence conditions should be objective, proportionate and non-discriminatory. The use of open licences should be promoted;

~~21. The term 'progressively' in article 5, paragraph 3, of the Convention and in paragraph 20 (d) and (e) of these recommendations should imply demonstrable progress with regard to the following parameters:~~

~~(a) The proportion of members of the public that have electronic access;~~

~~(b) The scope of information that is electronically accessible;~~

~~(c) The quality of electronic access;~~

~~(d) The level of understanding of user needs;~~

~~(e) The extent to which user needs are being met;~~

~~and that such progress should be communicated to the public;~~

Commented [FC3]: The recommendation is that the types of information in paragraph 20 should be made available in electronic form.

²⁹ The Aarhus Convention, article 5, paragraphs 1 (b) and 9.

³⁰ The Aarhus Convention, article 5, paragraph 7 (c), and article 9, paragraph 3.

³¹ The Aarhus Convention, article 5, paragraphs 2 (b) and (c), 3 (d), 7 (c) and 9.

³² The Aarhus Convention, article 5, paragraphs 2 (b) and (c), 3 and 9.

³³ The Aarhus Convention, article 5, paragraph 2.

³⁴ The Aarhus Convention, article 5, paragraphs 3 (a) and 4.

IV. TOOLS AND INFRASTRUCTURE

22. Environmental information can be disseminated to the public using the various [environmental electronic](#) information tools, as appropriate, including:

- (a) Special (one-stop access) portal dedicated to nationwide digital environmental information system;
- (b) General governmental portal;
- (c) Websites of the public authorities performing public functions, or the provision of public services related to the environment at the national/state, sub-national and local levels;
- (d) Portals of other key providers of information as relevant with respect to legislation, case-law, law-making, justice, other legal, policy and public records information;
- (e) Widgets;
- (f) Special mobile applications;
- (g) Social media and online media;
- (h) E-mail alerts;
- (i) Tools to access environmental information through bar-code or QR-code scanning;
- (j) Tools to access environmental information through touch-tone dialling;
- (k) Short message services (SMS) and mobile messaging applications;
- (l) Public electronic information kiosks;
- (m) Telephone hotline;
- (n) TV teletext³⁵.

23. Ensure that databases, registers, lists, inventories, cadastres and other resources containing environmental information listed in section III are developed, continuously maintained, and updated in digital form by default as integral parts of the nationwide digital environmental information system by promoting their interoperability, data sharing and public accessibility;

24. To ensure effective public access to environmental information, including listed in section III, develop if missing, continuously maintain and update a single one-stop access point based on a nationwide digital environmental information system that:

- (a) aggregates data and information resulting from different sources or provide [links](#) to other portals (see Annex, section V);
- (b) supports the implementation of the national “e-governance” and “Open Data” frameworks;
- (c) supports the implementation of the Shared Environmental Information System principles (see Annex, section III);
- (d) supports the implementation of the Earth Observations data management and sharing principles covering the entire data life cycle (see Annex, section II);
- (e) promotes machine-to-machine communication and the interoperability with statistical, geospatial, health and other information systems throughout the technical, semantic and legal dimensions;
- (f) allows using “cloud computing”;

25. Promote the development, continuous maintenance, and update of online general portals providing access to legislation, case-law, law-making, justice, other legal, policy and public records information systems using best available international standards. Ensure that resources of such systems should be properly categorized to environmental matters and made discoverable and accessible to the public in accordance with the Convention on the general portals and one-stop access point³⁶;

26. To support public participation in decision-making in environmental matters³⁷, the following tools can be used:

- (a) Electronic official notice boards of the public authorities;
- (b) Public advisory e-committees;

³⁵ The Aarhus Convention, article 5, paragraph 3.

³⁶ The Aarhus Convention, article 5, paragraphs 3 (b) and (c), 5, and articles 7-9.

³⁷ The Aarhus Convention, article 5, paragraphs 3 (d) and 7, and articles 6-8.

- (c) Web meetings or town halls;
- (d) Public e-consultations platforms;
- (e) E-petitions platforms;
- (f) Social media groups;

27. Encourage the use of the established emergency telephone numbers, radio emergency networks, media, including traditional media and social media, online portals and mobile applications used for the routine dissemination of environmental information to provide information to the public in case of imminent threat to human health and the environment as appropriate in accordance with the needs of different users³⁸;

28. Electronic information tools progressively should contain an open application programming interface to provide data and metadata as appropriate supported by clear technical documentation that is complete and available online. The set-up and use of the application programming interface should be based on several principles: availability, stability, maintenance over lifecycle, uniformity of use and standards, user-friendliness as well as security. If open application programming interfaces are not possible, electronic information tools should contain a publicly available justification. The progress should take into account the funds available to develop, maintain and update the tools in question;

29. Ensure the availability of machine-readable, user-friendly and easily transferable formats for the data and information listed in section III in a way that they can be shared and re-used;

30. Ensure continuous maintenance and update of electronic information tools and their content, including links, information on the reliability of the information sources and dates of the last update. If the competent authority ~~can~~ ~~decides~~ no longer ~~to~~ make available certain environmental information or electronic information tools for use or re-use, or ~~has~~ to cease updating those information or tools, it should make ~~this~~ ~~those decisions~~ publicly known ~~and give reasons~~, at the earliest opportunity, by electronic means where possible;

31. Promote and support efforts towards the development of methodologies and mobile applications and tools to provide the public with accessible, comprehensive, up-to-date and comparable information on environmental impact of products which enables consumers to make informed environmental choices;

32. Encourage the use of pilot and lab-based projects and state-of-the-art public engagement processes to develop and update electronic information tools or to apply new or emerging digital technologies, including data cubes, artificial intelligence, machine learning, blockchain, remote sensing, and the “Internet of Things”;

Commented [FC4]: Simply deciding not to do it should not be acceptable. The only reason should be incapacity to do it

V. ENGAGEMENT OF THE PUBLIC, OPERATORS AND OTHER INTERESTED STAKEHOLDERS

33. Provide the opportunities for public participation in ~~the~~ design, development and update of electronic information tools in accordance with ~~the national framework and~~ established good practices to ensure that the needs of different users are met;

34. Take the necessary measures as appropriate in accordance with best available international standards to make electronic information tools more accessible to the users, in particular to persons in vulnerable situations, including older people, people with disabilities, those with low literacy or language barriers, by making them perceivable, operable, understandable and robust;

35. Implement the onboarding for different types of potential users (for example, decision-makers, scientific community and researchers, education professionals, business operators, journalists, non-governmental organizations promoting environmental protection, Aarhus centres, indigenous people, children and youth, other groups of the public with specific interests) tailored to each electronic information tool;

³⁸ The Aarhus Convention, article 5, paragraph 1 (c).

36. Ensure that electronic information tools provide for an open source user-feedback mechanism, the opportunity to give feedback and comment on data and information accessibility, quality, sustainability of use and re-use as well as on ~~discovered~~ issues discovered or significant events that condition the interpretation of the data as appropriate;

37. Encourage the collection of local and indigenous knowledge, citizen science and crowdsourced data provided or generated by members of the public through citizen science observatories or other relevant initiatives and promote the interoperability of such data in accordance with best available international standards;

38. Promote the accessibility, use and interoperability of open research data in accordance with best available international standards;

39. Encourage operators whose activities have a significant impact on the environment to develop and use web based, mobile and social media applications in accordance with the national framework and best available international standards, as appropriate:

(a) to inform the public regularly of the environmental impact of their activities and products and other environmental information collected under a legal obligation to do so; and

(b) to inform the public authorities regularly and in case of imminent threat to human health and the environment to ensure that all information is disseminated immediately and without delay to members of the public who may be affected³⁹;

VI. GOVERNANCE, INSTITUTIONAL DEVELOPMENT AND CAPACITY-BUILDING

40. Establish, in physical and/or virtual environments, environmental information centres or equivalent settings that will promote public access to information and public participation in decision-making in environmental matters;

41. Promote access to electronically stored environmental information by establishing and maintaining Internet access points for local population in Aarhus Centres, public libraries, environmental information centres, museums, archives and other information sites;

42. Ensure proper consideration of environmental information management and accessibility within “e-governance” and “open data” governance frameworks;

43. Identify points of contact and data stewards that will be responsible for information management, dissemination of environmental information and maintenance of electronic information tools⁴⁰;

44. Promote the development and wider use of best available state-of-the-art electronic information tools as an effective instrument for putting into practice the Convention’s provisions, including through public-private partnerships;

45. Develop human capacity for the use of electronic information tools to promote the implementation of the Convention through comprehensive and forward-looking training and education programmes for public officials, scientific community and researchers, education professionals, business operators, journalists, non-governmental organizations promoting environmental protection, Aarhus centres, indigenous people, children and youth, women, other groups of the public with specific interests;

³⁹ The Aarhus Convention, article 5, paragraph 1 (b) and (c), 6 and 9.

⁴⁰ The Aarhus Convention, article 5, paragraph 2 (b).

46. Undertake measures to develop the institutional capacities of public authorities to collect, update, organize, store and disseminate environment-related information in electronic form by default and an easily accessible and user-friendly manner through a nationwide digital environmental information system;

47. Develop and apply comprehensive environment-related programmes, including specific training programmes linking the use of digital technology applications to the promotion of good environmental governance;

48. Share good practices, case studies, project outcomes and other useful material through the Aarhus Clearinghouse and its online databases, and support the maintenance of its national nodes;

VII. CLEARING-HOUSE MECHANISM

49. Maintain a national web site, preferably a one-stop access point (see paragraph 24 and Annex, section V), with information related to the nationwide implementation of the Convention and these Recommendations, which will serve as the national node of the Convention's clearing-house mechanism and provide its link to the Convention's secretariat for uploading in the Aarhus Clearinghouse;

50. Designate contact points responsible for collecting, managing and updating the information contained in the national node and for providing the necessary information for the central node of the Convention's clearinghouse mechanism, and undertake measures to disseminate information to the public on the clearinghouse mechanism; and

51. Develop capacity for public officials managing and updating information for the national node, and for providing the necessary information for the central node of the clearing-house mechanism.

ANNEX

Supporting explanatory notes

I. Terminology

To facilitate the use of these Recommendations, the following terms apply:

“**Aarhus Convention**” and “**Convention**” means the Convention on Access to Information, Public Participation in Decision-making in Decision-making and Access to Justice in Environmental Matters, done at Aarhus, Denmark, on 25 June 1998;

“**accessibility**” means set of principles and techniques to be observed when designing, developing, maintaining, and updating electronic information tools in order to make them more accessible to users, in particular persons with disabilities;

“**Akoma Ntoso**” defines a set of simple technology-neutral electronic representations in XML format of parliamentary, legislative and judiciary documents;

“**application programming interface**” (**API**) means a set of functions, procedures, definitions and protocols for machine-to-machine communication and the seamless exchange of data. Application programming interfaces can have different levels of complexity and can mean a simple link to a database to retrieve specific datasets, a web interface, or more complex set-ups;

“**artificial intelligence**” refers to systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals;

“**blockchain**” refers to a growing list of records, called blocks, that are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data. By design, a blockchain is resistant to modification of the data;

“**citizen science**” means a form of open collaboration in which members of the public participate voluntarily in the scientific process or environmental monitoring in various ways;

“**crowdsourcing**” means a method to obtain needed services, ideas, or content by soliciting voluntary contributions from members of the public, especially from an online community;

“**data**” refers to all types of data, including:

(a) **dynamic data** that means documents in a digital form, subject to frequent or real-time updates, in particular because of their volatility or rapid obsolescence (for example, data generated by sensors are typically considered to be dynamic data);

(b) **big data** that means data that contains greater variety arriving in increasing volumes and with ever-higher velocity;

(c) **research data** that means documents in a digital form, other than scientific publications, which are collected or produced in the course of scientific research activities and are used as evidence in the research process, or are commonly accepted in the research community as necessary to validate research findings and results;

(d) **citizen science data** that means data collected by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions;

“**data catalogue**” means a collection of metadata, combined with data management and search tools, that helps analysts and other data users to find the data that they need, serves as an inventory of available data, and provides information to evaluate fitness data for intended uses;

“**data cube**” refers to an approach to storing, processing and analysing large collections of environment-related earth observations and other data. The technology is designed to meet challenges of nationwide interest by being agile and flexible with vast amounts of layered grid data;

“**data harvesting**” means a process that copies datasets and their metadata between two or more data catalogues;

“data mining” means the practice of examining large databases in order to generate new information;

“data management” refers to management of information and data for secure and structured collection, update, storage, processing and access. Data management tasks include the creation of data governance policies, analysis and architecture; database management system integration; data security and data source identification, segregation and storage;

“digitalization” means the conversion of text, pictures, or sound into a digital form that can be processed by a computer;

“digital divide” means any uneven distribution in the access to, use of, or impact of information and communication technologies between any number of distinct groups;

“digital environmental information system” is an electronic system that allows sharing of all types of digital data, information, and knowledge relevant to the environment to be made available and accessible in accordance with the Convention.;

“e-Government initiatives” encompass activities of the public authorities to deploy information and communication technologies for improving knowledge and information in the service of the public;

“environmental information” means environmental information as defined

in article 2, paragraph 3 of the Convention;

“environmental indicator” means an indicator supporting all phases of environmental policy making, from designing policy frameworks to setting targets, and from policy monitoring and evaluation to communicating to policy-makers and the public;

“internet of things” means the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data;

“interoperability” means the ability of a computer system or software to work with other systems or products without special effort on the part of the user. It includes the technical, semantic and legal dimensions;

“linked data” refers to structured data which is interlinked with other data so it becomes more useful through semantic queries. It builds upon standard Web technologies such as HTTP, RDF and URIs, but rather than using them to serve web pages only for human readers, it extends them to share information in a way that can be read automatically by computers;

“machine learning” means the scientific study of algorithms and statistical models that computer systems use to perform a specific task without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence;

“machine-readable format” means a file format structured so that software applications can easily identify, recognise and extract specific data, including individual statements of fact, and their internal structure;

“meta data” means a set of data that describes and gives information about other data;

“mobile application” means application software designed and developed, by or on behalf of public authorities, for use by the general public on mobile devices such as smartphones and tablets. It does not include the software that controls those devices (mobile operating systems) or hardware;

“onboarding” means the actor process of familiarizing a new user with electronic information tools, taking into account the users’ needs, behaviour, experiences, and goals;

“open data” denotes data in an open format that can be freely used, re-used and shared by anyone for any purpose;

“open format” means a file format that is platform-independent and made available to the public without any restriction that impedes the re-use of information;

“open licence” means standardised public licences available online which allow data and other content to be freely accessed, used, modified and shared by anyone for any purpose, and which rely on open data formats (for example, custom-made licences, Creative Commons licences, Open Government licences for public sector information);

“open government data” initiatives encompass activities to make information or data produced or commissioned by governments available for everyone to access, reuse and redistribute without any restrictions;

“pollutant release and transfer register” means an environmental database or inventory of potentially hazardous chemical substances and/or pollutants released to air, water and soil and transferred off-site for treatment or disposal;

“public record” are any information or documents that are made by a public authority or public official and are required by law to be kept and maintained;

“public-private partnership” refers to a scheme that involves cooperation between the public and the private sector aiming at financing, designing, implementing and operating public sector infrastructure and services supporting the implementation of the Convention;

“re-use” means the use by the public of environmental information held by public authorities for commercial or non-commercial purposes other than the initial purpose within the performance of public functions or the provision of public services in relation to the environment for which the such information was collected. In technical terms re-use can be supported by data management principles (see Annexes II and III);

“semantic web” is a mesh of information linked up in such a way as to be easily processable by machines, on a global scale;

“standard licence” means a set of predefined re-use conditions in a digital format, preferably compatible with standardised public licences available online;

“text mining” means the discovery by computer of new, previously unknown information, by automatically extracting information from different written resources;

“timely manner” means with minimum time delays;

“user feedback” refers to a data quality component that includes information about the data directly provided by users based on their experiences using the data. It may include comments, quality assessments, discovered issues, usage reports, etc. It complements the data quality information provided by its producer.

II. Data sharing and data management principles developed by the Group on Earth Observation

1. Earth observations mean data and information collected about the planet, whether atmospheric, oceanic or terrestrial. This includes space-based or remotely-sensed data, as well as ground-based or in situ data.

2. The following data sharing principles and data management principles developed by the Group on Earth Observations⁴¹:

(a) data sharing principles:

- (i) data, metadata and products will be shared as Open Data by default, by making them available as part of the GEOSS Data Collection of Open Resources for Everyone (Data-CORE) without charge or restrictions on reuse, subject to the conditions of registration and attribution when the data are reused;
- (ii) where international instruments, national policies or legislation preclude the sharing of data as Open Data, data should be made available with minimal restrictions on use and at no more than the cost of reproduction and distribution; and
- (iii) all shared data, products and metadata will be made available with minimum time delay.

(b) data management principles:

Discoverability

DMP-1. Data and all associated metadata will be discoverable through catalogues and search engines, and data access and use conditions, including licenses, will be clearly indicated.

Accessibility

DMP-2. Data will be accessible via online services, including, at minimum, direct download but preferably ser-customizable services for visualization and computation.

Usability

DMP-3. Data will be structured using encodings that are widely accepted in the target user community and aligned with organizational needs and observing methods, with preference given to non-proprietary international standards.

DMP-4. Data will be comprehensively documented, including all elements necessary to access, use, understand, and process, preferably via formal structured metadata based on international or community-approved standards. To the extent possible, data will also be described in peer-reviewed publications referenced in the metadata record.

DMP-5. Data will include provenance metadata indicating the origin and processing history of raw observations and derived products, to ensure full traceability of the product chain.

DMP-6. Data will be quality-controlled and the results of quality control shall be indicated in metadata; data made available in advance of quality control will be flagged in metadata as unchecked.

Preservation

DMP-7. Data will be protected from loss and preserved for future use; preservation planning will be for the long term and include guidelines for loss prevention, retention schedules, and disposal or transfer procedures.

⁴¹ Referenced in the GEO Strategic Plan 2016-2025 and re-affirmed through the Ministerial Declaration adopted by the Group on Earth Observation at the twelfth plenary session (Mexico City, 11-12 November 2015) available at: http://www.earthobservations.org/open_eo_data.php#

DMP-8. Data and associated metadata held in data management systems will be periodically verified to ensure integrity, authenticity and readability.

Curation

DMP-9. Data will be managed to perform corrections and updates in accordance with reviews, and to enable reprocessing as appropriate; where applicable this shall follow established and agreed procedures.

DMP-10. Data will be assigned appropriate persistent, resolvable identifiers to enable documents to cite the data on which they are based and to enable data providers to receive acknowledgement of use of their data.

III. Shared Environmental Information Systems principles⁴²

1. A shared environmental information system (SEIS) means a concept underpinned by a series of principles designed to ensure that a digitally based system of systems allows interoperable flow of information about environmental monitoring, data, indicators, assessments, and knowledge.

2. The Shared Environmental Information System (SEIS) the following principles that information should be:

- (a) Managed as close as possible to its source;
- (b) Collected once and shared with others for many purposes;
- (c) Readily available to easily fulfil reporting obligations;
- (d) Easily accessible to all users;
- (e) Accessible to enable comparisons at the appropriate geographical scale and the participation of the public;
- (f) Fully available to the general public and at national level in the relevant national language(s);
- (g) Supported through common, free, open software standards;

3. A functional shared environmental information system should be structured around three pillars: content, infrastructure and cooperation. First, the system needs to identify the types of content (data) required, as well as potential sources. Second, an effective, web-enabled technical infrastructure is required that takes full advantage of the best available state-of-the-art digital technologies, including web services supported by machine-to-machine communication. Third, the cooperation and governance structure are required to manage human resources, inputs and networking.

⁴² See <https://www.unep.org/environmental-policy/environmental-monitoring-and-assessment/areas-of-work/shared-environmental-information-system.html>

IV. Metadata standards for digital environmental information system

1. All data should be accompanied by traceable and linked standardised metadata developed in accordance with standards established by the International Organization for Standardization⁴³, World Meteorological Organization⁴⁴, Open Geospatial Consortium⁴⁵ and other international forums as mandated.

2. All metadata should be users- and machine-readable, accompanied by an open licence and made accessible, preferably as part of an HTML Web page and via application programming interfaces (APIs).

3. The following metadata standards could be used to promote the interoperability between different information systems containing environmental information:

- (a) Dublin Core Metadata (DCMI) terms ([DCTERMS](#))⁴⁶;
- (b) Data Catalogue Vocabulary (DCAT)⁴⁷, including GeoDCAT-AP and StatDCAT-AP;
- (c) XML for parliamentary, legislative and judiciary documents (Akoma Ntoso)⁴⁸;
- (d) Web Map Service (WMS)⁴⁹;
- (e) Web Coverage Service (WCS)⁵⁰;
- (f) Catalogue Service for the Web (CSW)⁵¹;
- (g) Statistical Data and Metadata eXchange (SDMX)⁵²;
- (h) Water Markup Language (waterML)⁵³.

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⁴³ See <https://www.iso.org/standards-catalogue/browse-by-ics.html>

⁴⁴ See <https://public.wmo.int/en/resources/standards-technical-regulations>

⁴⁵ See <https://www.ogc.org/docs/is>

⁴⁶ See <https://dublincore.org/>

⁴⁷ See <https://www.w3.org/TR/vocab-dcat-2/#introduction>

⁴⁸ See <http://www.akomantoso.org/>

⁴⁹ See <https://www.ogc.org/standards/wms>

⁵⁰ See <https://www.ogc.org/standards/wcs>;

⁵¹ See <https://www.ogc.org/standards/cat>

⁵² See <https://sdmx.org/>

⁵³ See <https://www.ogc.org/standards/waterml>

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V. One-stop access point for environmental information

1. Develop as described below a national portal dedicated to environmental information that can serve as a one-stop access point with access to all information and data for the whole environmental domain, ensuring easy access to the users to other portals, maintaining individual units of the digital environmental information system and harvesting information for reporting at the national, regional and international level, as appropriate;
2. Link this national portal through the use of open application programming interface, RSS feeds and others tools to other thematic portals, platforms, and data hubs (local, national and international) forming a system of systems where discovery, access to data, information, and knowledge can be found following open data sharing and data management principles (see also sections II and III and Annex, sections II-IV);
3. Enable the use through the portal of best available state-of-the-art digital technology tools, such as data cubes, blockchain technology, linked data, text mining, semantic web tools, “cloud computing” and artificial intelligence (see also paragraph 32);
4. Develop the onboarding system for different types of the users and take the necessary measures to make the portal accessible taking into account their needs (see also section V).
5. Ensure direct access through the portal to disaggregated data, as appropriate, including to space-based and other data outlined in paragraph 19 (d) and (e), citizen science and crowdsourced data;
6. Provide information on the points of contact to support the public in seeking access to information under this Convention;
7. Ensure that each webpage of the portal containing information and links should be updated regularly and contain the date of the last update and the information source;
8. The content of the one-stop access point (portal) can include the following themes:
 - (a) Introduction
 - (b) Reports on the state of the environment
 - (c) Environment themes (overview of legislation, policy, programmes, plans, international commitments, monitoring, data/data sources, environmental indicators, assessments, viewers, scenarios, good practices in accordance with section III of these Recommendations)
 - (i) Air and Atmosphere
 - (ii) Climate
 - (iii) Water
 - (iv) Soil
 - (v) Land
 - (vi) Ocean and Sea
 - (vii) Subsoil and mineral resources
 - (viii) Natural sites and landscape
 - (ix) Forests
 - (x) Biological diversity
 - (xi) Genetically modified organisms
 - (d) Factors (overview of legislation, policy, programmes, plans, international commitments, data/data sources.)
 - (i) Pollutant release and transfer register

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- (ii) Chemicals management
 - (iii) Waste management
 - (iv) Energy efficiency and consumption
 - (v) Noise
 - (vi) Radiation
 - (vii) Use of natural resources
 - (viii) Product passports and other product-related information
- (e) Decision-making in environmental matters:
- (i) Public consultations
 - (ii) Strategic Environmental Assessment
 - (iii) Environmental impact assessment and state ecological expertise
 - (iv) Licensing and permitting
- (f) Activities, measures and good practices
- (i) Economic-environmental accounting
 - (ii) Eco-labelling scheme
 - (iii) Eco-audit scheme
 - (iv) Producer responsibilities
 - (v) Green procurement
 - (vi) Public-private partnerships and environmental agreements
 - (vii) Funded environmental projects
 - (viii) Good practices on better environmental management, sustainable consumption and production, best available techniques, green procurement, green and circular economy and sustainable development
- (g) Environmental compliance and enforcement
- (h) Environment-related hazards and emergencies
- (i) Dashboard and maps
 - (ii) Situation reports
 - (iii) Mitigation and remediation measures taken by the public authorities
 - (iv) Prevention, mitigation and remediation measures for the public in the affected area
 - (v) Crowdsourcing data
 - (vi) Media resources
 - (vii) Training and e-learning
- (i) Public records
- (j) Research and education
- (k) Publications and downloads
- (l) Public engagement:
- (i) Official notice board
 - (ii) Aarhus Convention, its implementation and compliance
 - (iii) Access to information
 - (iv) Citizen science and crowdsourcing
 - (v) Participation in decision-making in environmental matters

(vi) Access to Justice

(vii) Accessibility statement and capacity-building for onboarding process tailored to different user needs

(m) Media news and resources

(n) Points of contact

(o) Specifications for re-use of data and information

(p) Use terms and conditions