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## Eurofleets+ Data Management Plan



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## 1. Eurofleets+

Eurofleets+ is an H2020 funded project that runs from 2019-2023. The main objectives of the Eurofleets+ project is to provide access to a European fleet of twenty seven Research Vessels to scientists for a specific cruise, and to advance the technical capabilities of ocean exploration by investigating six equipment innovations.

Three different programmes will be launched, each with either two or more calls or a continuous call. Proposals are evaluated by a Scientific Liaison Panel, especially on the basis of scientific and technical quality. All marine scientific fields are considered. The grantee becomes the (co-)Principal Investigator of the cruise and is expected to generate one or more datasets. In order to streamline the proper management of these datasets a set of complementary Data Management Plans (DMPs) are developed.

Data management is an integral part of Eurofleets+, and the different aspects of it have been spread over different work packages. This DMP is the outcome of deliverable 1.3: Eurofleets+ Data Management Plan. The deliverables relating to Data Management are:

Deliverable	Name	Partner	Date
D1.3	Eurofleets+ Data Management Plan	RBINS	30/07/19
D3.1	EVIOR portal with selected functionality	MARIS	30/09/19
D3.2	EVIOR portal with full functionality	MARIS	30/07/22
D3.5	Specification of required improvements and additions of shipboard data management system	CSIC	30/09/19
D4.10	Data management plan template for funded cruise	RBINS	30/05/19
D4.11	Data management plan tool (customized DMPonline)	RBINS	30/07/19
D4.12	Data handling chain setup	RBINS	30/09/19
D4.13	Data management follow-up report for funded cruises	RBINS	30/07/20
D4.14	Data management follow-up report for funded cruises	RBINS	30/01/22
D4.15	Synthesis of the data management follow-up reports, lessons learned and recommendations	AWI	30/01/23
D9.14	Eurofleets + data sets catalogue	MARIS	30/07/19

## 2. Eurofleets+ Data Management Plan

Data management covers many aspects: adequately describing the data and the metadata (including future contact persons and processes), ensuring long-term appropriate storage and preservation of the data and metadata, documenting possibilities for dissemination and re-use by licenses and data sharing, and handling procedures for sensitive data. These activities need to be documented so that all partners know their responsibilities and in order to ensure they are actually followed through.

The previous Eurofleets projects only had a data policy, that didn't specify any real procedures, which made it difficult to find the distinct scientific results that the cruises generated. Eurofleets+ overcomes this by defining a data workflow from data creation to data dissemination and by following well-

established processes in data management. Additionally, this workflow ensures long term data storage while remaining interoperable. The data management work will be performed by three reference data centres.

Data management practices will be described in this DMP in coordination with the responsible organisations. As the data management practices of Eurofleets will evolve through time and are dependent on the number and objectives of the cruises and of the results of other deliverables, this DMP is considered a living document. Clear filename versioning will be used, following the H2020 deliverable template.

### **3. Reference data centres**

The data management work will be performed by three reference data centres (NODCs) on data files prepared by the principal investigator. These centres are the Hellenic Centre for Marine Research (HCMR) in Greece, the Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS) in Italy and the Belgian Marine Data Centre (BMDC). All datasets will be passed to these NODCs. They will decide amongst themselves on what criteria the datasets will be assigned. The decision model will be described in this DMP. It will most likely be based on the marine area the cruise takes place in and the scientific discipline. On what basis the datasets are assigned needs to be communicated to the EMODnet DIP Masters so that they can apply this decision in the EMODnet DIP back-end and assign the datasets to the reference data centres.

### **4. Cruise-specific DMPs and General DMP**

Each applicant for a funded cruise must complete a cruise-specific preliminary DMP that must be completed when the cruise is granted and extended when new information is available.

The cruise-specific DMPs take the form of a set of questions and answers in the DMP Roadmap web application specifically tailored to the needs of Eurofleets+. The application is hosted on <https://dmp.ef-ears.eu>; applicants must make use of this application and create a login account for it. They are required to write a two-step DMP: a preliminary one, provided as a pdf export during the application (first deadline: September 2nd, 2019), and a full DMP, ready after the cruise is granted and before the cruise starts. These DMPs are also living documents and should only be altered by the PIs themselves, possibly after consultation with the reference data centres.

The general DMP (i.e. this document) does not make use of the DMP Roadmap tool. It will be extended with an overview of the funded cruises at the time they are granted without going into detail. A tabular summary of the cruises, their datasets, the assigned reference data centre and the data management steps will be produced. This overview will categorize the datasets of the funded cruises according to the information of table 1. The overview is an annex of this general DMP.

### **5. Eurofleets+ data policy**

The Eurofleets+ data policy

(<https://www.eurofleets.eu/access/sea-call-oceans/eurofleetsplus-data-policy/>) states that applicants have to create a Data Management Plan, that their datasets have to be transmitted to the reference data centres, and that it is possible to have an embargo lasting for up to two years after the cruise.

## 6. Cruise data

### Data summary

Cruise data is all data that is gathered during the operations of an Eurofleets+ funded cruise. This comprises en-route data acquisition systems, human operations and by (un)deploying (a group of) sensors like frames, ROVs, AUVs or floats.

- En-route data acquisition by a platform: location, meteorology, thermosalinometry, FerryBox,
- Human operations: physical measurements such as a CTD profile or water transparency; measurements and observations derived water, sediment or biota samples; occurrence observations
- Long-term timeseries by deployed sensors

Each applicant for a funded cruise must complete a cruise-specific preliminary DMP when the cruise is granted and extended when new information is available. This DMP details, amongst others:

- What data types will be gathered for which purpose
- Volume of data expected
- How the data will be transferred to shore
- What data processing (conversions, cleaning, quality control and harmonisation) they be applied
- Which (parts of the) data will be made openly accessible, for whom and when (embargo)
- How the metadata of the datasets will be documented, especially with regards to data processing and lineage
- How files will be organised, both externally and internally (e.g. filenames, versioning, internal consistency)
- How the meta-information of the measurement is documented and when it is ready for intake into a repository
- Which license will be used
- What provisions for data security there are before intake into repository
- Whether any other guidelines are followed

Given the breadth of marine scientific fields it is impossible to detail all possible data types and scenarios at this stage.

The PI should organise and name files according to the data category in table 1. As the EMODnet Data Ingestion Portal (DIP) will be used, one data submission should be performed per cruise and all files should be combined into one single zip archive.

Eurofleets+ will use the achievements of the SeaDataNet (SDN) and Eurofleets 1 (EF1) and 2 (EF2) projects, which simplifies the number of file formats and constraints the workflows and software tools. The EF+ data will be eventually converted to the SeaDataNet data transport formats:

- SeaDataNet ODV4 ASCII for profiles, time series and trajectories,
- SeaDataNet NetCDF with CF compliance for profiles, time series and trajectories,
- SeaDataNet MedAtlas as optional extra format,
- NetCDF with CF compliance for [3D observation data such as ADCP](#).

Table 1 provides an overview of the possible data types.

Category	Platform	Science	Matrix	Measurement type	spatiotemporal geometry	format at acquisition time	format at submission time	final format
En-route data acquisition	R/V, ROV, AUV, Float	Physics		Location	trajectory	Proprietary output files/network message	csv/ODV/NetCDF	ODV/NetCDF
En-route data acquisition	R/V, ROV, AUV, Float	Physics	air	Meteorology	trajectory	Proprietary output files/network message	csv/ODV/NetCDF	ODV/NetCDF
En-route data acquisition	R/V, ROV, AUV, Float	Physics, chemistry	water	Thermosalinometry	trajectory	Proprietary output files/network message	csv/ODV/NetCDF	ODV/NetCDF
En-route data acquisition	R/V, ROV, AUV, Float	Physics, chemistry	water	AUMS/FerryBox	trajectory	Proprietary output files/network message	csv/ODV/NetCDF	ODV/NetCDF
Long-term timeseries by deployed sensors	compound sensor	Physics, chemistry	water	Frame with multiple sensors	Point timeseries	Proprietary output files	csv/ODV/NetCDF	ODV/NetCDF
Long-term timeseries by deployed sensors	Single sensor	Physics, chemistry	water	Any single sensor (current meter, sea level,... )	Point timeseries	Proprietary output files		
Human operations	R/V	Physics	air, water, sediment	CTD profiles	Profile	Proprietary output files	csv/ODV/NetCDF	ODV/NetCDF
Human operations	R/V	Physics	air, water, sediment	Ad hoc physical observations	Single point in time and space	Proprietary output files/spreadsheet	csv/ODV/NetCDF	ODV
Human operations	R/V	Physics, Chemistry, Geology, Biology	water, sediment, biota	Water, sediment or biota samples	Single point in time and space	spreadsheet	csv/ODV	ODV
Human operations	R/V	Geology, Biology	Sediment, ecology	Human observations	Single point in time and space	spreadsheet	csv	ODV
Imagery data	R/V, ROV, AUV, Float	Geology, Biology	Sediment, ecology	Images	Single point in time and space	Image	n/a	n/a

Table 1. Overview of data types, purposes and formats. Not all data types are relevant for Eurofleets+, for instance deployed sensors fixed-point timeseries are not expected. Note that there is no pathway for sound or imagery data; data derived from these data types should be stored as csv.

## Data and metadata workflow, including required meta-information

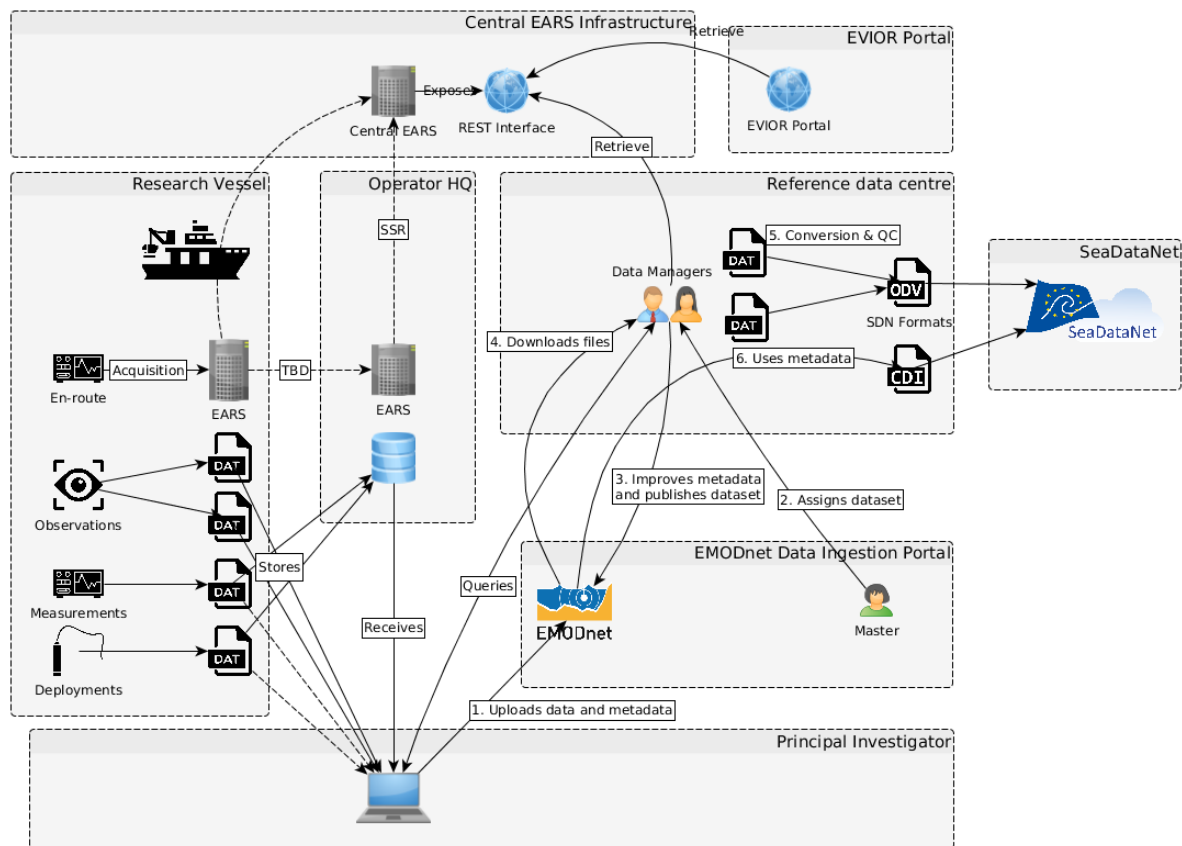


Image 1. Complete dataflow. Dotted lines are either to be implemented or optional (in the case of the principal investigator).

### Dataset scope and metadata

When an Eurofleets+ cruise is granted, the cruise is created in the Eurofleets Cruise Programme database on the EVIOR portal (<http://eurofleet.maris2.nl/startpage.html>) by MARIS staff.

The PI is asked to provide as rich metadata as possible on two levels: the cruise (via the SeaDataNet Cruise Summary Report) and the datasets (using metadata elements based on the ISO 19115 standard). In the guidelines for the cruise DMP, specific attention is put on lineage metadata (provenance + curation steps).

Within two weeks after the cruise ends, the PI must create a Cruise Summary Report according to the 'User Guide for Cruise Summary Reports' of BSH ([http://seadata.bsh.de/csr/online/UserGuide\\_V2.pdf](http://seadata.bsh.de/csr/online/UserGuide_V2.pdf)). He or she should add Eurofleets+ as EDMERP project, so that later aggregation works correctly. BSH will be informed of this so that they can correct the CSR with the Eurofleets+ project if the PI forgot this.

The EVIOR portal will recuperate the CSRs flagged with Eurofleets+ and improve the previously provided information.

All metadata of cruise datasets (trajectories, timeseries, CTD profiles, sample-based measurements and observations) must be provided by the data submitter within two months (together with the data)



after the results are obtained to the EMODnet Data Ingestion Platform (DIP). Obtaining the result corresponds to the time a set of results are first stored on a digital medium (eg. to allow sample analyses in a lab). The submission follows the EMODnet DIP two-phase procedure as explained on [https://www.emodnet-ingestion.eu/media/emodnet\\_ingestion/org/documents/helpguide\\_ds\\_22sept2017.pdf](https://www.emodnet-ingestion.eu/media/emodnet_ingestion/org/documents/helpguide_ds_22sept2017.pdf).

An Eurofleets + data sets catalogue (D9.14) will be developed by MARIS, and its information will be harvested from the EMODnet DIP and shown on the EVIOR portal.

**The data submitter may either be the Principal Investigator himself, or at least a person who possesses all relevant datasets, as there can only be one dataset submission, with one archive of data files.**

The data may also be stored in any other repository, but this will not be part of the official submission.

In order to be able to submit the dataset in EMODnet DIP, the data submitter should create a Marine ID for himself first. The ingestion portal is hosted on <https://submission.emodnet-ingestion.eu/insite.php?module=submitter>. The submitter starts phase 1, step 1 and completes the metadata of the dataset and uploads the data files as a zip. He should report Eurofleets+ in the 'Project / Programme' field of the 'Data types' tab. The DIP Master will assign one of the EF+ reference data centres as a Leading Data Centre. The data centre will then continue to phase 1, step 2 and publishes the dataset after verifying the completeness of the metadata. After this, the data centre moves on to phase 2 and starts with data curation for intake into the appropriate European infrastructures (first SeaDataNet which bridges to EurOBIS and EGDl).

### *General data*

All data of cruise datasets (trajectories, timeseries, CTD profiles, sample-based measurements and observations) must be provided by the data submitter within two months after the result is obtained by using the EMODnet data ingestion platform. Only data gathered during Eurofleets+ cruises will be treated by the reference data centres. For en-route data, Eurofleets functions as a testbed to improve its uptake into international data repositories.

The datasets are then processed (phase 2) by one of three reference data centres for uptake into SeaDataNet (SDN). They should follow the standard procedures and software provided by SeaDataNet.

SeaDataNet allows data centres to either perform its procedures on incoming data as flat files (already QC'ed or not) or on an inhouse database. In the former the files are converted by two desktop data management applications, NEMO, Octopus (and in the case of vertical profiles, ODV). In the latter, the data centre imports files into a database, and often applies a set of internal QC procedures. Mixed approaches also exist.

- NEMO is used to convert ASCII text files ('csv') to the SeaDataNet file formats (ODV, MedAtlas and netCDF) and to link the metadata description of the data granule (created by using MIKADO) to the actual data.
- Octopus can convert the different SeaDataNet file formats (ODV, MedAtlas and netCDF) to each other and performs QC on them.
- ODV allows to visually inspect vertical profile datasets by plotting the (in)dependent variables in two or more dimensions.
- MIKADO allows to create instances of an ISO 19115 profile, named Common Data Index (CDI) xml files. These files describe the data granule. MIKADO can operate on a database or on files

already processed by NEMO, Octopus or ODV. CDI files makes the data discoverable in the CDI portal.

For Eurofleets+, the data centres are free in their choice to work up the data to the relevant file format plus CDIs, based on the data flows they are more familiar with, but they should apply the same set of quality controls. The data centres will agree on how to encode the local identifier in the CDI and how to represent the lineage information between the DIP and the CDI. This will be further specified in D3.1.6 and some operational procedures.

SeaDataNet syncs the datasets with the EUDAT Cloud Repository and in turn exchanges the dataset to the relevant EMODnet portals. Geology datasets are exchanged to EGD. Biological datasets are also processed using ODV/CDI and later exchanged by SeaDataNet to EMODnet Biology/EurOBIS (which uses DarwinCore which will not be used here).

Continuous data should be provided in the following file formats:

- CTD profiles should be manually provided via the EMODnet DIP in ASCII csv, Ocean Data View or netCDF (preferred) files. Sending proprietary file formats (e.g. SeaBird files) is discouraged.
- Trajectory (en-route, underway) data from the R/V, limited to meteorology, thermosalinometry: will be automatically provided via the EARS acquisition module. See en-route data, below.
- AUMS data such as turbidity, OBS, chlorophyll, algae, CDOM, CO<sub>2</sub>, nutrients,... may be manually provided via the EMODnet DIP in ASCII csv, Ocean Data View or netCDF (preferred) files.-
- Trajectory data from ROVs and AUVs should be manually provided via the EMODnet DIP in ASCII csv, Ocean Data View or netCDF (preferred) files.
- Fixed-point timeseries are not expected as a single cruise would not provide enough opportunity for long-term time series. If they would be provided possible formats are ASCII csv, Ocean Data View or netCDF (preferred)

Non-continuous data such as sample-based measurements and observations, especially for chemistry, geology and biology, and ad hoc physical measurements, should be reported in a csv format using a standardized excel sheet that contains all necessary column headers for the reference data centres. This template will be made available to the principal investigators, so that each uses the same column headers and provides the same level of information.

### *Operations meta-information*

The Eurofleets 1 and 2 EARS software stack broadly provides solutions to storing the meta-information of research operations (events such as arriving at station, sampling,...), en-route data acquisition; and defined a data transfer file format based on XML named the SSR (Ship Summary Report) and a tool to create it (the SSR Maker).

The meta-information of research operations is stored by using the EARS front-end application. The application provides an export function that lists all the on-board events as a csv file. This file has to be provided during the data submission in the EMODnet DIP.

### *En-route data*

The SSR Maker is responsible to pack a set of files: the last 24h information on tracks, meteorology, thermosalinometry and events; to list the last track position, last meteo and last thermosalinometry information at the time the SSR Maker was run; together with basic info like vessel identifier and cruise id.

During Eurofleets 2, no fixed automated vessel-to-shore transport protocol for the SSR files has been developed, although ad hoc strategies using rsync have been used on some vessels. For Eurofleets+ Deliverable 3.5 one or more reference vessel-to shore strategies will be implemented (limiting bandwidth).

Vessel operators must install the whole EARS stack in the autumn of 2019, so that is operational at the time the first cruises depart (beginning 2020). A revised installation manual based on the Eurofleets 2 manual will be made available in September 2019 by RBINS. In order for the installation to go more smoothly, the application stack will be put inside a docker container.

If for some reason either the installation of EARS, or the automated vessel to shore transmission does not materialize in individual R/Vs, either during the installation period (September-December 2019) or the first operational period (2020) or the second (2021-2023), alternatives to using the SSR are provided. In this case, R/V operators should provide cruise tracks and all en-route data as NetCDF files. The EARS acquisition module can export NetCDF. For this, operational procedures will have to be agreed with individual vessel operators.

The EARS developments will be finished near the end of 2020 (deliverables 3.7-3.9). In the meantime, during 2020, the Eurofleets 2 SSR generator and SML structure will be used for data transfer. A second period follows In the context of Task 3.1.6 and Deliverable 3.1 it will be examined if the the level of detail present in the SSR of underway data is good enough for their goals (display purposes on EVIOR and uptake in data repositories).

The en-route data will be processed and quality controlled by the reference data centres. For this semi-automated processing workflows will be programmed (D3.1.6).

## Licenses

The Principal Investigator (PI) of the cruise project chooses the license and must report this in the cruise DMP. This license is respected throughout the dataset lifecycle. The Guidance for the Cruise DMP makes it clear that open data and machine-actionable licenses are preferred. The applicants have been informed about the Creative Commons licenses and their rights.

## Embargoes

A PI can decide to add an embargo of up to two years after the cruise. Data and metadata submission to the reference data centres is still mandatory within the two-month period. In this case however, the dataset will not appear in the public datasets list of EMODnet DIP; therefore phase 1 will remain unfinished. For the contribution of the datasets to SeaDataNet, the data centres should already perform the conversion to SeaDataNet files and the QC using tools like NEMO and Octopus. Creation of the coupling table and CDI entry with MIKADO and making the files available to the Replication Manager can wait until after the end of the embargo.

D 4.12 will further elaborate on these aspects and the DMP will be adapted accordingly.

## Data FAIRness assay

We provide here a short analysis to what level of FAIRness the data will be uplifted. For this we used the Force11 FAIR data principles (<https://www.force11.org/group/fairgroup/fairprinciples>)

### *Data findability and enriched with metadata*

The data will be findable in at least two different data portals, EMODnet Data Ingestion Portal and SeaDataNet. In both cases the datasets are annotated with rich ISO 19115 metadata. Depending on the dataset type the datasets will be made available in other data repositories connected to SeaDataNet; these are not discussed here. All repositories are searchable. The dataset in the EMODnet

Data Ingestion Portal does not automatically receive a digital object identifier, but can be given one. The data granule in the SeaDataNet system receives a file identifier in URN form that can be traced back to the local data centre record. Both are present in the metadata record as a file identifier (SDN) or additional identifier (DIP).

### *Accessibility*

To our knowledge, the EMODnet DIP does not make the metadata available by making use of its identifier, nor is there an open (machine-readable) protocol to access them. The data remains easily accessible.

The Common Data Index is made available through CSW (for metadata, Catalog Services for the Web), as well as WMS and WFS. These are open, free and universally implementable protocols developed by OGC. The CDIs are planned to be exposed via a SPARQL endpoint as well.

### *Interoperability*

The information represented in the metadata in both EMODnet DIP and SeaDataNet corresponds to the FAIR principles of Force11, as fields like the cruise, the R/V platform, the involved organisations, the sea areas and the observed physical properties refer to linked data representations of these concepts, stored in registers (European directories, i.e. here relevant EDMO, EDMERP and CSR) and vocabularies (NERC/BODC vocabularies P02, C17 and C19). The data as processed by the Principal Investigator is, and as such provided on the EMOnet DIP, only interoperable on a limited level. Via the Cruise DMP Template, PI's are advised to accompany the data with as much meta-information as possible.

The SeaDataNet datafile formats (ODV, MedAtlas and NetCDF) are extended and restricted variants of these existing file formats and add linkages to external resources and have a mandatory semantic header (using the same directories and vocabularies as above).

### *Re-use*

The EMODnet DIP allows data providers to document the provenance/lineage by providing the processing methodology, the data quality processing steps and relevant documentation. Data providers are stimulated to give as much information as possible. The metadata format the DIP is based on (ISO 19115) is one of the main standards in the domain. The wrapped datasets are provided in a raw state, and processed into more usable formats through the SeaDataNet system. In the SeaDataNet metadata format (CDI), it is also possible to provide QC check results and provide a lineage statement.

The base license of the dataset is up to the data provider and he is stimulated through the DMP Template to provide an open data usage license (CC0, CC-BY, CC-BY-NC,...). SeaDataNet applies its own usage license which states that re-use should be reported to the data owner, reminds them of proper acknowledgement and stimulates co-publication.

## **JRA data**

The projects listed in 'JRA 3.2 Equipment innovations for deep sea operations from vessels' and 'JRA 3.3: Intelligent robot exploration' could lead to new software and data. Not all projects (e.g. those in JRA 3.2.) have a field-testing phase and will therefore not generate any scientific data.

A simple DMP should be created on a project-by-project basis for the technological developments. Below we list some questions that can be answered. The DMP can be stored as a text document and should be adapted as the need arises.

## Data and software summary

- Will any data be generated during the course of the specific equipment JRA project? Can you indicate type, formats and size and differentiate between scientific data (related to the marine environment) and system data related to analysing or optimizing the technology itself?
- Will the new developments yield more accurate or precise data compared to actual technology? Or are the advancements on the level of higher cost-effectivity?
- What pieces of software will be generated during the prototyping? Can you indicate their purpose and language? Please differentiate between 'drivers' (running on the platform) and 'evaluation software' (used to assess the viability or superiority of the new technology). The latter may just be a statistical analysis. If yes, please specify them. The rest of the questions regarding software can be ignored if so.

## Data and software accessibility

EF+ stimulates open licenses for the innovation projects (data and software) but acknowledges that out of commercial interest and protection of intellectual property there are reasons for not doing so.

### *Software*

- Would releasing the software help new innovations get a headstart and set the stage for new developments in the field?
- What will be the licensing for the software drivers running on the platforms?
- What will be the licensing for the QC software evaluating the innovation?

### *Data*

- Scientific data that is of a higher quality than generated using actual technology merits being made public in international marine data repositories. Is this the case?
- Do you plan to release such scientific data? If yes, please contact a representative from the Eurofleets+ Data Management Team.
- What will be the licensing for the scientific data?
- Do you plan to store the technology-related data in a data repository? Which one and is this a public repository?
- What will be the licensing for the technology-related data?

## Making data and software findable

- How will you share software and data between team members, especially across institutes? How will you foster the collaborative nature of the work? If access is restricted, how is single access enforced?
- How will software be versioned?

If data and/or software are released:

- Will you make use of an embargo period?
- Which software and data repository will you use?
- For software, do you plan to add documentation on how to use it in the repository?

## Making data and software interoperable

### *Software*

- Do you plan to make drivers or evaluation software compatible with existing technology or best practices so that they can find wider adoption (either internally or externally)?

## *Data*

If scientific data is released:

- Would you agree to make the data available using common standards in the field, such as a Sensor Observation Service, NetCDF files or make use of the SeaDataNet infrastructure?