

DELIVERABLE

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Revision 1	16.6.2024	Margit Gföhler	TUW	Add datasets from partners

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1 EXECUTIVE SUMMARY

This deliverable constitutes the initial Open Science and Data Management Plan (DMP) for the EIC Pathfinder Open project BioMembrOS. The main purpose of the DMP is to guide the implementation of the FAIR – Findable, Accessible, Interoperable, Re-usable – principles of the European Commission for data and other research outcomes. It specifies Data Governance and handling of data during the lifetime the project and beyond, lists the types of data are expected to be generated, whether and how it will be made open and accessible for verification and re-use, how it will be curated and preserved, and also addresses security issues. BioMembrOS is committed to openness according to the Horizon Europe principle "as open as possible, as closed as necessary".

2 Key word list

Artificial organs

Artificial respiration

Biomimetic membranes

Data management

Data management plan

Deliverable

Dissemination

EIC Pathfinder Open

FAIR

Horizon Europe

Open Access

3 List of acronyms and terms

CA	Consortium Agreement
CC	Creative Common license
DMP	Data Management Plan
DOI	Digital Object Identifier
EC	European Commission
GA	Grant Agreement
OA	Open access
PM	Project Management Board
WP	Work Package

CC0 – creative common license in which creators waive all their copyright and related rights in their works to the fullest extent allowed by law.

FAIR principles — ‘findability’, ‘accessibility’, ‘interoperability’ and ‘reusability’.

Open access — Online access to research outputs provided free of charge to the end-user.

Open science — An approach to the scientific process based on open cooperative work, tools and diffusing knowledge.

Research data management — The process within the research lifecycle that includes the organization, storage, preservation, security, quality assurance, allocation of persistent identifiers and rules and procedures for sharing of data including licensing.

Research outputs — Results to which access can be given in the form of scientific publications, data or other engineered results and processes such as software, algorithms, protocols, models, workflows and electronic notebooks.

4 Introduction

This deliverable D1.2 presents the first version of the Data Management Plan (DMP) for the EIC Pathfinder Open project BioMembrOS, and is submitted to the European Commission at M6, June 2024. The DMP is, in fact, a living document and it will be updated with the project's progress. Updates will be submitted in deliverables D1.4 (M24) and D1.7 (M42).

This initial document details the approach of the BioMembrOS consortium to Open Science and Data Management. It describes overall Data Governance in the project, including the lifecycle of data to be collected, generated, used, or processed within the project and the handling of data, including methodologies, data sharing, privacy and security considerations, legal and regulatory requirements, open access, during the project and beyond.

BioMembrOS follows the principle "as open as possible, as closed as necessary", and this document is based on the Horizon Europe Open Science strategy (https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/programme-guide_horizon_en.pdf).

Data generated during the project will adhere to FAIR Principles for data collection and management: Our data will be Findable, Accessible, Interoperable, and Reusable. Data will be housed in a persistent repository using the Zenodo platform. Data will also be assigned identifiers and described through metadata as best as possible. In addition, the project will try to use language that is easily searchable, translatable, and retrievable in adherence to catalogue, dataset, and distribution metadata layers.

Dissemination of BioMembrOS results is supported by Open Science measures of Open Access (OA), Open Data, and Open Source. All public deliverables and results will be freely published on the project website and on the projects Zenodo platform. The project will use open licenses for deliverables, documentation, and publications. Creative Commons CC-BY4.0 will be the default. The project follows an OA strategy for all scientific publications arising out of the project.

The main objective of the Data Management Plan (DMP) is to provide a structure on how data used (Provided Data) or generated (Project Data) will be managed through the duration of the BioMembrOS project and beyond. The DMP addresses the different data types in the project; and how data will be formatted, stored and shared following the FAIR Data Principles and in connection to the Data Protection considerations defined in the Grant Agreement (GA). The DMP can continuously be updated during the whole duration of the project as new data and datasets will be used or created within project execution.

The guiding principle of BioMembrOS project is to openly share any outputs as far and as soon as possible, restrictions only apply for data which is needed for IPR. All data and other research outputs will be managed in line with the FAIR principles using the Zenodo platform.

As stated in the GA, the consortium will adopt an open strategy on knowledge management and protection through:

- immediate (as soon as pre-prints are available) full open access to all peer-reviewed scientific publications using the Zenodo platform;
- deposition of public deliverables in the Zenodo platform and on the BioMembrOS webpage;
- all derived data, with exemption of data that need to be protected for exploitation and protection of IPR, will be curated, exploited and made available for verification and re-use via the Zenodo platform and on the scientific knowledge platform ResearchGate;
- information will be provided about research outputs, tools, instruments needed to validate the conclusions of scientific publications or to validate/re-use research data, via metadata and where appropriate as attachments to publications;

5 Identified data sets

The consortium has identified a number of datasets, key details of these data sets are summarized in the following Table 1. 'Data utility' indicates for which applications, to which user groups the data might be useful outside the project.

Dataset Name	Sub datasets	Partner responsible	Other partners involved	Type	Origin	File formats	Expected Size	WP & tasks	Expected time of release	Accessibility	Embargo necessary	Keywords	Data utility
CFD	CFD.T31	TUW	UNIBO, UJ	Tabular data, images	generated	ASCII	Up to 1000 MB	WP3, T3.1	M9	Open access	YES (time to publish/ eventually patent)	Flow distribution, Mass Transfer, Shear Stress	Geometrical Optimization of Fiber Shape
CAD	CAD.T32	TUW	UNIBO	Drawings	generated	stl	Up to 400 MB	WP3, T3.2	M12	Open access	YES (time to publish/ eventually patent)	Fiber Shape and Micro-channel Drawings	Production of membrane fibers
PRT	PRT.T33	TUW	IST	3D Printing Operating Files, Optical Microscopy Images	generated	stl, JPEG, TIFF	Up to 500 MB	WP3, T3.3	M12	Open access	YES (time to publish/ eventually patent)	Fiber, 3D printing	Production of membrane fibers
PIV	PIV.T34	TUW	all	Tabular data, images	generated	JPEG, TIFF	Up to 1000 MB	WP3, T3.4	M16	Open access	YES (time to publish/ eventually patent)	Micro-PIV, Flow Distribution	Verification of CFD Data

CFD	CFD.T35	TUW	UJ	Tabular data, images	generated	ASCII	Up to 1000 MB	WP3, T3.5	M22	Open access	YES (time to publish/ eventually patent)	Optimization, Flow distribution, Mass Transfer, Shear Stress	Design Optimization
OPT	OPT.T35	TUW	all	Tabular data, Models	generated	MATLAB	Up to 300 MB	WP3, T3.5	M22	Open access	YES (time to publish/ eventually patent)	Optimization, Modelling	Design Optimization
CFD	CFD.Q1	UNIBO	TUW	Tabular data	generated	ASCII	Up to 100MB	WP4, T4.2	M23	Open access	NO	CFD, shear stress, flow distribution	Geometrical optimization of membrane modules
ERT	ERT.Q1	UNIBO	TUW, all	Tabular data	generated	csv	Up to 10MB	WP4, T4.4	M28	Open access	NO	ERT, residence time distribution, flow distribution	Model validation
CAD	CAD.1	UNIBO	TUW	Drawings	generated	stl	Up to 100 MB	WP4	M18	Open access	YES (time to publish/ eventually patent)	Fiber shapes, drawing	Production of membrane fibers
PRT	PRT.1	UNIBO	TUW	3D printing operating file	conversion of stl files CAD.1 for printing	stl1	Up to 300 MB	WP4	M18	Open access	YES (time to publish/ eventually patent)	Fiber, 3D printing	Production of membrane fibers

SEM	SEM.1	UNIBO	all	image	generated	jpg	Up to 10MB	WP4	M18	Open access	NO	Fiber, structure, image	SEM images of the printed fibers
FLUX	FLUX.1	UNIBO	TUW/LIS	Tabular data	generated	xlsx	Up to 50 MB	WP4	M23	Open access	NO	Flow, Pressure, Flux	Characterization of 3D printed fibers
MEMBR	MEMBR.1	IST		Tabular data	Generated	xlsx	Up to 10 MB	WP5, T5.1	M18	Open access	YES (time to publish and possible patent)	Membranes, Gas permeation	Conditions, optimization, and performance of flat sheet membranes
MEMBR	MEMBR.2	IST		Image	Generated	jpg, tiff	Up to 50 MB	WP5, T5.1	M18	Open access	YES (time to publish)	Membranes, MOFs, Image	SEM images of MOFs and membranes
FIBER	HOLFIB.1	IST	TUW	Tabular data	Generated	xlsx	Up to 10 MB	WP5, T5.2	M24	Open access	YES (time to publish)	Hollow fibers, Processing conditions	Casting solutions, conditions, and optimization for hollow fiber spinning
FIBER	HOLFIB.2	IST	TUW	Image	Generated	jpg, tiff	Up to 50 MB	WP5, T5.2	M24	Open access	YES (time to publish)	Hollow fibers, Image	SEM images of the hollow fibers
PUDOPE	PUDOPE.1	IST	TUW, all	Tabular data	Generated	xlsx	Up to 10 MB	WP5, T5.3	M32	Open access	YES (time to publish)	PU dope solutions, Processing conditions	Casting solutions, conditions, operating

													parameters, and optimization for 3D printing
PUCOAT	PUCOAT.1	IST	UKA	Tabular data	Generated	xlsx	Up to 10 MB	WP5, T5.4	M18	Open access	YES (time to publish/ possibly patent)	Hemocompatibility, PU coating	Optimization of physicochemical properties
3DCOAT	3DCOAT.1	IST	UNIBO, TUW	Tabular data	Generated	xlsx	Up to 10 MB	WP5, T5.5	M32	Open access	YES (time to publish)	Fiber coating, Processing conditions	Conditions and optimization of coating parameters
3DCOAT	3DCOAT.2	IST	UNIBO, TUW	Image	Generated	jpg, tiff	Up to 50 MB	WP5, T5.5	M32	Open access	YES (time to publish)	PU fiber, Image	SEM images of the PU-coated 3D-printed fibers
Morphometry_Fish_Gills	No	UJ	N/A	Tabular data, textual data, and images	Reused	Power point, jpeg, tiff, png, txt, csv,	Up to 5MB	WP2, T2.3	M8	Open access	No		Anyone interested in the functional design of fish gills
Morphometry Avian_Lung	No	UJ	N/A	Tabular data, textual data, and images	Reused	Power point, jpeg, tiff, png, txt, csv,	Up to 5MB	WP2, T2.3	M8	Open access	No		Anyone interested in the functional design of the avian lung.

Collagen_ structure	No	UJ		Tabular data, textual data, and images	Generated	Power point, jpeg, tiff, png, txt, csv,	-	WP2, T2.3	M9	Open access	YES (time to publish), expected early in 2025		Anyone interested the structure and function of the blood-gas and water blood barrier
Modelling	Mod.1	UKA	all	Tabular data	generated	tif, jpg xlsx	Up to 50MB	WP6 T6.1	M35	Open access	No	In vitro shear flow	Blood trauma
Mass transfer	O ₂ /CO ₂	UKA	UNIBO, TUW,IST	Tabular data	generated	xlsx	Up to 3MB	WP6 T6.2	M42	Open access	No	In vitro O ₂ /CO ₂	Gas transfer
Residence time	Visualization	UKA	UNIBO, TUW, IST, MUW	Textual data, images	generated	tif, jpg xlsx	Up to 50MB	WP6 T6.3	M38	Open access	NO	Suspension	Validation
Design	In vitro investigations	UKA	TUW, UNIBO	Tab. data, images	generated	tif, jpg xlsx	Up to 100MB	WP6 T6.4	M38	Open access	No	Modell validation	Flow characteristic
Prototype	Design/validation	UKA	TUW, IST	Tab.data, images, SEM	generated	tif, jpg xlsx	Up to 150MB	WP6 T6.5	M42	Open access	No	Blood trauma/ gastransfer	Integration of fibers
BGA		MUW			generated	Pdf	up to 5 MB	WP7	M16	Open access	NO	pH, CO ₂ &O ₂ , pCO ₂ &pO ₂ , HCT	Everyone who deals with the topic of extracorporeal CO ₂ removal
CBC		MUW			generated	Pdf	up to 5 MB	WP7	M16	Open access	NO	Complete Blood Count	Everyone who deals with the topic of

													extracorporeal CO2 removal
CRA		MUW			generated	Pdf	up to 5 MB	WP7	M16	Open access	NO	Cytokine Release Assay	Everyone who deals with the topic of extracorporeal CO2 removal
Blood damage		MUW			generated	Pdf	up to 5 MB	WP7	M16	Open access	NO		Everyone who deals with the topic of extracorporeal CO2 removal
ROTEM		MUW			generated	Pdf	up to 5 MB	WP7	M16	Open access	NO		Everyone who deals with the topic of extracorporeal CO2 removal

Table 1. Identified data sets

Most of the identified datasets are expected to have long-term value and will be useful to different user groups including:

- Scientific community (Researchers and students in membrane science, artificial respiration and artificial organs in general)
- Stakeholders from industry, medical institutions, professional organizations
- General Public

6 FAIR data

6.1 Making data findable, including provisions for metadata

BioMembrOS will utilize the Zenodo platform as the main tool for preserving and sharing research output. Zenodo is a catch-all repository that allows all researchers to archive and share their research objects with the world-wide research community.

Zenodo ensures the discovery and citability of the research output by assigning a Digital Object Identifier (DOI) to every upload, as well as promotes software citation and preservation through one-click integration with GitHub. A metadata section is included with each dataset that is uploaded on Zenodo and search keywords will be identified that will to optimize the possibility for discovery and then potential re-use.

Where applicable, raw datasets will be stored together with processed data, names of the datasets will include suffixes that indicate status of the data (eg _raw).

6.2 Making data accessible

Repository:

BioMembrOS already has established a project repository on the Zenodo platform (Figure 1), which is accessible through <https://zenodo.org/communities/biomembrOS>. A DOI is issued to every published record on Zenodo.

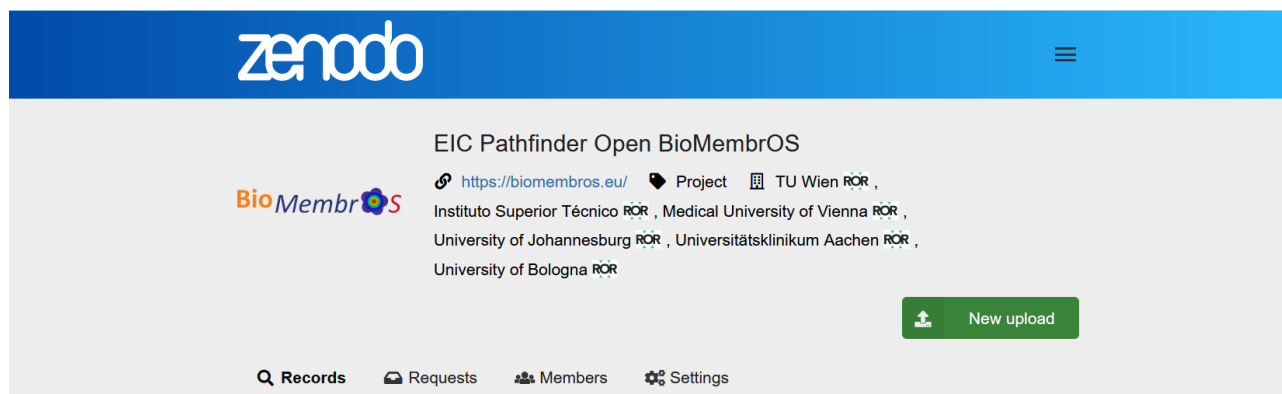


Figure 1: BioMembrOS repository on the Zenodo platform

Data:

Already identified datasets are listed above in Table 1. Data will be stored under the suitable Creative Commons licenses, following the principle ‘as open as possible and as closed as necessary’. Figure 2 illustrates the main procedure used in the project to ensure open access to research data and publications. Only data which has to be protected for exploitation will not be made openly available. Data that is used for scientific publications will be held back until acceptance of the publication, Table 1 indicates which datasets will require such an embargo.

Data will be acquired in file formats associated to the instrument the data is generated on and can be usually read out by anyone who is in possession of the dedicated acquisition software. However, to facilitate exchange and re-use of data, datasets will as far as possible be exported and stored in formats that are commonly accessible (e.g. .txt, .csv), including the associated metadata and additional comments and descriptive text to aid the interpretation of the data.

Access of data stored on Zenodo is free of charge. Download of data is anonymous, only the country of origin of the request (based on IP address) will be stored for 1 year.

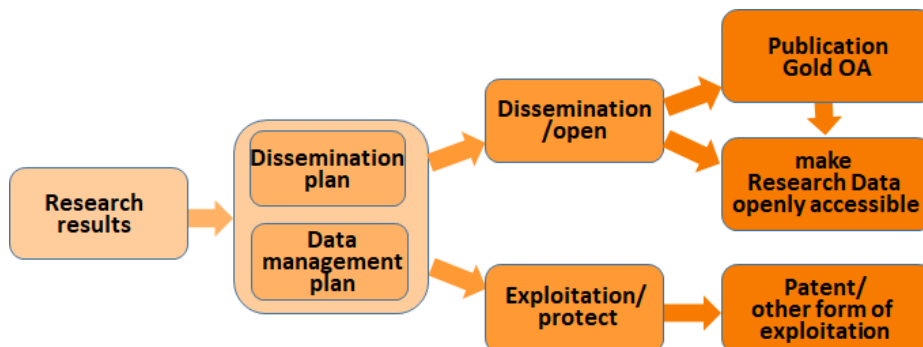


Figure 2: Decision path for handling of research results

Metadata:

Metadata associated with each published data set in Zenodo is licensed under creative common CC0, except for email addresses. All metadata is exported via OAI-PMH and can be harvested. All metadata is stored internally in JSON-format. Access to metadata and data files is provided over standard protocols such as HTTP and OAI-PMH.

Metadata for each uploaded dataset contains by default the following information:

- *Resource type*
- *Title*
- *Publication date*
- *Creators*
- *Abstract/description*
- *Access and licensing information*
- *Contributors*
- *Keywords and subjects*
- *Languages*
- *Dates*
- *Version*
- *Funding (Grant information)*
- *Related works*
- *References*
- *Software (Repository URL, Programming language, development Status)*
- *Publishing Information for Journal/Conference publications*

Metadata to each uploaded dataset will contain all necessary information to enable the user to access the data.

The consortium has defined several general keywords for all public datasets, publications and deliverables, these are:

Artificial respiration, Biomimetic membranes, Horizon Europe, EIC Pathfinder

Data including rich Metadata will be available and findable for a long time also after the end of the BioMembrOS project. Zenodo guarantees data storage for at least 20 years. The BioMembrOS cloud contents (Data including Metadata) will be stored on the TUV server for at least 5 years after the end of the project.

6.3 Making data interoperable

‘Structural’ interoperability refers to the syntax of the data exchange and ensures that data exchanges between information technology systems can be interpreted at the data field level.

Data will be produced or collected in standard file formats associated to the instrument the data is generated on or in the formats specific software uses, and can be read out by anyone who is in possession of the dedicated software. For structural interoperability, to facilitate exchange and re-use of data, data sets will be exported and additionally stored in formats that are more generally accessible (see also above section ‘Making data accessible’).

‘Semantic’ interoperability refers to interoperability at the highest level, which is the ability of two or more systems or elements to exchange information and to use the information that has been exchanged, meaning not only data is received but the data includes all vocabulary and information so that the receiving information technology systems can interpret the data.

To ensure the interoperability of the data on the semantic level, standard vocabularies will be used when applicable, including vocabularies from commonly accepted literature in the specific field. Abbreviations and acronyms will always be written in full and clarified the first time they are used.

6.4 Increase data re-use

To increase data re-use, rich metadata with all required information is essential. In the section ‘Abstract/description’ of the metadata all necessary information on methodology, codes, data cleaning, analyses, variable definitions, units of measurement, etc. will be provided to facilitate data re-use.

Quality control for each uploaded dataset is the responsibility of the partner (see section 8). Additionally, uploaded datasets will be checked by the PM and feedback will be given to the partner if editing is required for fulfilling the FAIR principles.

To maximize possible data re-use, BioMembrOS will follow the principle ‘as open as possible and as closed as necessary’. Wherever possible, research datasets will be available under the Creative Commons Attribution 4.0 (CC BY 4.0) license, allowing third parties to share and adapt data with no restrictions as long as attribution (i.e. citation) is provided.

7 Other research outputs

Currently, no other research outputs have been identified. However, for the update of the Data Management Plan at M24 the consortium will discuss and consider whether other research outputs could be made available for sharing in accordance with the FAIR principle.

8 Allocation of resources

Data management including contributions to the data management plan is part of WP1 ‘Project Management and Coordination’ and covered by the allocated person months, each beneficiary has allocated 3 person months in this WP.

Each partner is responsible for the management of the research data generated in the WP they are leading (Table 2). This includes making the data FAIR, quality control and uploading it to both the BioMembrOS owncloud storage and to the Zenodo platform and provide all required Metadata (also on the owncloud storage).

WP	Lead partner
WP2	UJ
WP3	TUW
WP4	UNIBO
WP5	IST
WP6	UKA
WP7	MUW

Table 2: Lead partners for technological work packages

The costs associated with making the data FAIR (Findable, Accessible, Interoperable, and Reusable) will be part of each partners contribution to WP8 ‘Dissemination, exploitation and communication’, each beneficiary has allocated 5 person months in this WP.

Use of the Zenodo platform is free of charge. Cost for the project owncloud storage BioMembrOS@tuprocloud.tuwien.ac.at is covered by TUW.

9 Data security

Data stored on the Zenodo platform is safe as it is stored in the CERN Data centre. Both data files and metadata are kept in multiple online and independent replicas. CERN has considerable knowledge and experience in building and operating large scale digital repositories and a commitment to maintain this data centre to collect and store 100s of PBs of LHC data as it grows over the next 20 years. In the highly unlikely event that Zenodo will have to close operations, they guarantee that to migrate all content to other suitable repositories. Since all uploads have DOIs, all citations and links to Zenodo resources (such as datasets) will not be affected.

Independently from the Zenodo platform, all data, datasets documents and files must be kept at the software drives of each responsible partners’ organization. Each partner is obliged to maintain the data regarding backups and secure storage (with limited and protected access to team members only), guaranteeing that only users relevant to project implementation have access to the Project Data and Provided Data during the duration of the project and beyond. Access to data and datasets will be set up by the respective IT departments of each organization.

All data on the BioMembrOS project owncloud storage will be stored securely with limited and protected access by TUW during the project’s lifetime and for a minimum of 10 years after. TUW will also follow the ‘Policy for Research Data Management (RDM) at TU Wien’ (attached), which ensures a minimum retention period for research data and records of 10 years after either the assignment of a persistent identifier or the publication of a related work following research completion, whichever is later.

10 Ethics

As no personal data will be processed (see section ‘ethics self-assessment’ in the GA), no ethics or legal issues that can have an impact on data sharing are expected.

11 Discussion

This deliverable D1.2 ‘Data Management Plan’, summarizes the planned activities to manage and share research output and making it FAIR following the principle ‘as open as possible and as closed as necessary’.

This document defines data types, data formats, naming conventions, document formatting and data management, as well as the FAIR principles adopted by the BioMembrOS project, and data security aspects foreseen to achieve the project’s objectives.

This deliverable is meant to guide all partners of the project in the handling, storing and sharing of data and datasets in order to deliver the highest quality outputs and maximize the impact for the project. The DMP will be followed and applied during the entire duration of the project and applied to all relevant research output, and will be updated, if necessary, for revisions and for the creation of new versions of the DMP as planned at M24 and M42.

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