Ref. Ares(2025)11399175 - 19/12/2025

ZEROF

Updated Data Management Plan

Deliverable D1.4

Version N°1

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Co-funded by the European Union

Also funded by the Swiss State Secretariat for Education, Research and Innovation (SERI).

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This deliverable is based on the project Grant Agreement, Consortium Agreement, relevant guidelines by the European Commission, and the VTT general template for the Project Data Management Plan deliverable.

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Document information

Grant Agreement	n°101092164
Project Title	Development of verified safe and sustainable PFAS-free coatings for food packaging and upholstery textile applications
Project Acronym	ZeroF
Project Coordinator	Miika Nikinmaa, VTT
Project Duration	1 January 2023 – 31 December 2025 (36 months)
Related Work Package	WP1 Coordination and management
Related Task(s)	1.4 Data management
Lead Organisation	VTT
Contributing Partner(s)	IDEA, AEI, ALL
Due Date	31.12.2025
Submission Date	19.12.2025
Dissemination level	Public

History

Date	Version	Submitted by	Reviewed by	Comments

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Summary

This deliverable is the updated Data Management Plan for the ZeroF project. This is the final version of the living document which has been updated throughout the project. This report is intended primarily for the ZeroF consortium, and external stakeholders interested in evaluating the data management procedures of the project. Monitoring the Data Management Plan implementation and coordinating the data management have been the tasks of the appointed Data Manager (Nina Jeliazkova, IDEA).

ZeroF has generated data through administrative and research related tasks, which relate to the main subject areas of the research. Different methods have been used to collect the data, e.g., relevant infrastructure software has been used where needed and typical methods for stakeholder engagement like interviews, questionnaires, and workshops. Datasets have been processed and analysed using relevant software. The operations are GDPR compliant regarding personal data and fulfil the FAIR principles. Personal Data Management is detailed in the ethics deliverable D1.2 which was submitted to the Commission in March 2023.

The main objective of ZeroF is to develop and validate two novel Safe and Sustainable by Design (SSbD) PFAS-free hybrid coating formulations. The developed coating materials has been tested in packaging and textile applications to demonstrate coating performance while building an exploitation pathway through stakeholder engagement, consumer, and regulatory acceptance activities, including certification road-mapping. ZeroF has also developed and demonstrated guidelines and computational tools for SSbD of novel materials in practice.

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Abbreviations and acronyms

Acronym	Description
CC-BY	Creative common licence
CC-BY-SA	Creative common license
CERN	European Organization for Nuclear Research
CSC	Standardized access protocols
DOI	Digital Object Identifier
EEA	European Economic Area
EUDAT	Collaborative Data Infrastructure
GDPR	General Data Protection Regulation
FAIR	Findable, Accessible, Inter-operable, Re-use
IDA	Fair data storage
IPR	Intellectual Property Rights
LCA	Life Cycle Assessment
PDMP	Project Data Management Plan
PFAS	Per- and Polyfluoroalkyl Substances
SSbD	Safe and Sustainable by Design
VTT	Technical Research Centre of Finland
WP	Work Package

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1 Introduction

This deliverable outlines the Updated Data Management Plan (DMP) of the ZeroF project, the deliverable D1.3 that has been submitted on M3. This report is intended primarily for the use of the ZeroF consortium, and for external stakeholders interested to evaluate the data management procedures of the project. Monitoring the DMP implementation and coordinating the data management have been the tasks of the appointed Data Manager, Nina Jeliazkova (IDEA).

ZeroF has generated data through administrative and research related tasks in the main subject areas of the research. Different methods have been used to collect the data, e.g., relevant infrastructure software have been used where needed and typical methods for stakeholder engagement like interviews, questionnaires, and workshops. Datasets have been processed and analysed using relevant software. The operations are GDPR compliant (regarding personal data) and fulfil the Findable, Accessible, Inter-operable and Re-usable (FAIR) data principles. Personal Data Management is detailed in the ZeroF ethics plan deliverable D1.2 which was submitted to the Commission in March 2023.

Quality control measures have been taken to maintain the accuracy of data during the project. Potential re-utilisation of any open data has been ensured by careful documentation of datasets as well as description and publication of data collection methods, protocols, workflows, and models. The project consortium has appropriate technical and organisational measures in place to carry out data management and protection during the project. Project documents have been stored on Microsoft Teams-based ZeroF workspace to which all project partners have access.

The consortium is strongly committed to promoting open science. All the scientific articles, conference papers, public deliverables and project reports produced have been published according to the open access principles: publicly available and stored repository. All publishing partners had budgeted funding to cover open access costs, all generated public research outputs have been published openly without delay, and they are stored in a public repository. The public repository Zenodo operated by OpenAIRE has been used.

Findability is supported by using persistent identifiers (DOI) and used in linking to datasets. Creative Commons license CC-BY-SA or CC-BY have been used for datasets compiled from public sources. Data generated by project partners is not shared with open licenses dur to confidentiality issues and potential patents and exploitation. The open datasets are shared in interoperable formats.

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2 ZeroF Data management

2.1 Overview of data

ZeroF has generated data through research related and administrative tasks, which relate to the main subject areas of the research. The generated data has been divided into the following two categories:

1) Research related activities and data, such as desktop reviews, stakeholder engagement activities, Life Cycle Assessments (LCA) and via the research infrastructure and equipment used for experimental and development work.
2) Administrative tasks and data (such as minutes, agendas).

Experimental work at laboratory and pilot test units has generated experimental and numerical research data, images, and text. The data includes physical property data, process parameters and qualitative and descriptive data for the substances and processes. Data from material research includes e.g., melting point, flash point, degradation temperature and flame retardancy, solubility, pH-value, density measurements, solid content, rheometric data (e.g. viscosities), spectroscopic data (e.g. nuclear magnetic resonance (NMR) spectroscopy data, infra-red (IR) spectroscopy data, Raman-spectroscopy data, inductively coupled plasma (ICP) mass spectrometry data), contact angles, surface energies, spray test and Bundesmann test data, mechanical property data such as strength properties, Martens hardness and abrasion resistance, barrier property data, scanning electron microscopy (SEM) images, light scanning microscopy (LSM) images and particle characterization techniques including Fraunhofer diffraction and low angle X-ray diffraction (XRD). Environmental and toxicological data that has been collected include cytotoxicity, biodegradability, mutagenicity, aquatic toxicity using Daphnia magna, and in vitro methods for inhalation and particle toxicity, irritation, and respiratory sensitisation. Researchers have been examining the possibilities of re-using open research data or other pre-existing data, software or algorithms or standards, as available.

Different methods have been used to collect the data. For example, relevant infrastructure software has been used where needed and typical methods for stakeholder engagement like interviews, surveys, questionnaires, and workshops have been utilised.

The data has covered the main subject areas of the research, such as coating experiment data and synthetisation work analysis. The main types used for the datasets are raw laboratory data, qualitative and quantitative data, personal data, digital image and video data, and different reports. The main formats of data are handwritten and digital (lab) notebooks, data from analytical techniques, logs, Excel, csv, tab, documents, and reports in the format of Word, ppt, pdf, different image, and video formats like png, jpeg, mp4. Personal data has been collected on a minimum level possible, including details like name, organisation, title, and contact details of consortium members. The volume of data has been moderate considering the main outputs are different report documents, laboratory, and experimental data as well as different campaign materials. The videos produced in the project have been the biggest datasets.

The datasets have been processed and analysed using relevant software. The data analysed in connection with the project work has been produced by the project. Relevant open data was used for material safety assessment and model predictions.

Quality control measures have been taken to maintain the accuracy of data during the project. Potential re-utilisation of any opened data has been ensured by careful documentation of datasets as well as description and publication of data collection methods, protocols, workflows, and models.

An overview of the data generated and collected as well as how it has been handled in ZeroF is depicted below in Table 1 per type of data and linked to Work Package (WP) level activities.

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Table 1 ZeroF project type of generated data, and project activities and used software during the project

Type of data	**Nature of data**	**Format of data**	**Open access**	**ZeroF activities and used software during the project**
Raw laboratory data	Laboratory experiments, results	Notebooks, logs, csv files	NO, metadata possibly	WP2, WP3, WP4: The processing and the analysis equipment have stored the raw laboratory data on their system hard drives. A paper processing documents where notes are handwritten during the processing trials and are stored in the appropriate processing trial folder. Laboratory notebooks are kept during measurements
Quantitative data	Lab experimental, material composition data and analytical performance data, Model predictions	Excels, csv, tab (numerical data, units)	Consortium will define what will be published, after that decision of open access will be done case by case	WP2, WP3, WP4: Analysing equipment data WP5: computational data, quantitative data from lab experiments, chemical and material databases, AMBIT software (ambit.sourceforge.net), REST API, eNanoMapper.adma.ai, https://elab.zerof.adma.ai/ WP6: safety assessment data, LCA data, economic assessment data, databases. All stored in MS office formats WP7: Quantitative data of the dissemination and communication activities stored in an Excel file. The data includes description of the D&C activity, target audience, communication channel, outcome and link. ZeroF webpage uses Matomo Analytics for analytics, a web analytics service provided by Matomo. Matomo Analytics uses "cookies", which are text files placed on the computer to help the website analyse how visitors use the site. Consortium will first define what will be published, after that decision of open access will be done.

Qualitative data	Interview, survey, questionnaire, workshop results	Notebooks, excel, word	YES (only metadata where required)	WP6: Consumer survey WP7: Data obtained through interviews, surveys, questionnaires and workshop for dissemination and communication activities in word, Notes files and recordings. The data has been used for press releases, blog notes, social media posts and articles.
Personal data (data minimization)	From participants of workshops, surveys, questionnaires, interviews	Name, title, organization, contact details	NO	In the case personal information was required, this was treated as confidential and has been handled in accordance with data protection and regulation (GDPR). WP1: Data related to the experts in the Advisory board, project mailing lists and meeting participation lists WP6: Consumer survey, Final workshop and awareness campaign, Questionnaire, ISO experts, WP7: Personal data for organizing two events with stakeholders (mailings), final exploitation workshop and for impact study have been handled. Data relevant for the dissemination, and communication activities, such as mailing and participant lists, with the participants' consent. Awareness campaign
Digital image and video data	Images, videos, workshops, news and media items, communication materials	Image and video formats (jpeg, mp4, etc.)	YES (no confidential content)	WP7: Awareness campaign, videos
Documentation	Project reports, deliverables	Word, pdf, ppt	YES, when public	For documentation, standard Microsoft Office programmes like Word, Power Point and Excel have been used with ZeroF visual identity WP1: Public deliverables D1.2, D1.3, and D1.4

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				WP5: D5.1, D5.2, https://elab.zerof.adma.ai/ WP6: Public deliverables D6.1, D6.2, D6.6 and D6.7 WP7: Public deliverables D7.1, D7.2, D7.4, D7.5 and D7.6

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2.2 Data processing practicalities

ZeroF data processing has been done according to the following principles:

- Project data, including research and administrative information, has been stored in project's Microsoft Teams channel, whenever possible. Role-based security and multifactor authentication are implemented to prevent unauthorised access.
- All relevant partners have committed to fill in Research Metadata template in Teams or harmonized data entry templates in eNanoMapper database. eNanoMapper was selected.
- During the last year, WP5 promoted Electronic Lab Notebook for structural storage of laboratory, computational data and SSbD at https://elab.zerof.adma.ai/
- Data processing follows GDPR and national legal requirements, ensuring confidentiality and data protection.
- Regular quality control measures are in place to maintain data integrity and minimise the risk of data loss or corruption.
- Sensitive and personal data are handled with strict confidentiality, and access is granted only on a need-to-know basis.
- To ensure proper risk management of the project, including data processing, the consortium has agreed on proactive risk management practices. For example, all partners are responsible for flagging to the coordinator any potential risks or deviations from the plan. Risks have been discussed in all Management Committee meetings and new risks have been identified and mitigated as necessary.
- In case of any question ZeroF Data Manager Nina Jeliazkova, who is in charge of monitoring and advising in data related topics of the project, provides answers.

3 FAIR Data

3.1 Making data findable, including provisions for metadata

Discipline compliant metadata elements have been used describing the data to aid data discovery and potential re-use. Persistent identifiers provided by the repository are being used in identifying and linking to datasets.

The WP5 database at https://enanomapper.adma.ai/projects/zerof/ provides free text and faceted search, which is capable of aggregating search results from local and remote databases (based on the widely used Apache Solr search engine). If the metadata is open, it can also be configured to be indexed by the Google Dataset search.

Each data entry in database is assigned with a release version tag.

User friendly data entry templates with ontology annotation support and lab notebooks workflow can make the metadata creation faster and more reliable.

Annex 1 presents the content of research metadata that have been used in the project. Information was collected frequently.

3.2 Making data openly accessible

Decisions concerning the sharing of datasets have been taken by the General Assembly throughout the project when necessary. The coordinator, in collaboration with project participants, has taken appropriate measures to make relevant data openly available and usable for third parties for study, teaching and research purposes.

During the project, data has been used mainly by the consortium members. The consortium decided in the final consortium meeting that, after selecting what will be published, open accessibility for other data for third party will be done case by case. If, after project closure, permission to re-use the data is required, all requests for further use of data will be considered carefully and whenever possible approved by the data owner or by the General Assembly if needed. Permission for data use will be granted providing that there are no IPR, or confidentiality issues involved or any direct overlap of research questions with the primary research. Permission will be provided by request using the appropriate procedure described in connection with other metadata.

The primary focus in data sharing has been on the data underlying prospective scientific publications ensuring the validation of results presented in publications. In addition to the summary data, also operational or raw data will be opened when benefits and possibilities for successful raw data re-use are recognised and there are no confidentiality or commercialisation issues involved or identified. Decisions will be made case by case.

FAIR-compatible data is being archived in eNanoMapper database and ELN designed for SSbD support at https://elab.zerof.adma.ai/. These repositories are only accessible by partners. Upon decision by consortium, subsets of data will be archived at Zenodo. The metadata of the datasets will be opened under the public and open copyright license, CC0.

Justification for possible case-specific embargo for published data are decided by the project consortium. The embargo will be sought, if necessary, in connection with possible IPR protection or any potential patent, utility mode etc. application based on project results.

No definite period or time limit is planned for access to data. However, the opened data will be deposited in Zenodo. No perpetual data curation policy to guarantee full long-term digital preservation of datasets is planned at this point.

3.3 Making data interoperable

Variables and value names have been constructed following the general data processing conventions and standards common to the research subject. WP5 uses open-source FAIR database, which includes mapping the vocabulary to ontology terms and provides programmatic access via REST API for data analysis. During the last reporting period WP5 established an Electronic Lab Notebook, with specific structure to support SSbD at https://elab.zerof.adma.ai/. The ELN approach was described in a publication "Towards Addressing Co-Creation Gaps: Automating Safe-and-Sustainable-by-Design Workflows with Electronic Lab Notebooks" by Nina Jeliazkova, Nikolay Kochev, Luchesar Iliev, Vedrin Jeliazkov, and Giampaolo Campana Presented at 21st Global Conference on Sustainable Manufacturing (GCSM 2025), to appear in Lecture Notes in Mechanical Engineering (Springer).

3.4 Increase data re-use

After the project completion, the ownership of datasets will belong to the project partners that generated them. Creative Commons license CC-BY-SA or CC-BY or similar public copyright license will be used unless there are compelling reasons to select more restricted license. Creative commons licenses will, by default, also include a disclaimer of liability for the re-use of opened data.

The data quality has been assured by following appropriate quality control and curation methods, e.g., rigorous control of any incoming data by well-managed data profiling (formats, value distributions and data consistency and completeness will be assessed for any incoming data); logically defined data pipeline with centralized data management preventing duplicate data entering the system; capturing and documenting data conditions and scenarios with their dependencies and conditions; maintaining data integrity with checksums and triggers, if necessary; enhancing data and metadata lineage traceability for the pipeline, thus enabling more effective data governance. Research teams have regularly checked the quality of not just the data, but also related software, algorithms, and workflows when and if changes are made to them.

4 Other research outputs

Any other project outputs, which will be needed for verifying or analysing the data - software, algorithms, workflows, protocols, or models - will be assigned open license alongside the corresponding data. The software implementing the workflow for conformal prediction for VEGA QSAR models is available at GitHub and will be released under open license upon publication (paper in preparation).

5 Allocation of resources

Making research data quality-controlled, FAIR-compatible, and as open as possible has been considered by the consortium members while allocating resources to the project. During the project duration, costs related to research data management and opening are eligible as part of the project funding.

Each consortium member has been responsible for covering their costs during pre- and post-grant phases with their own funding. During the project, consortium partners have been responsible for managing and curating datasets in their possession while the central data in the Microsoft Teams platform has been administered by VTT as the coordinator of the project. Long-term preservation and sharing of datasets are the responsibility of the project coordinator.

By the end of the project, each consortium member has taken appropriate measures to ensure the long-term preservation and sharing of opened datasets.

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6 Data Security

Each project partner is responsible for their research related data collection and dataset management as well as use. Moreover, each partner must ensure that their datasets are correctly recorded. In addition, a FAIR database e.g., eNanoMapper has been selected as an option. eNanoMapper.adma.ai has been extended with SSbD support using electronic lab notebook at https://elab.zerof.adma.ai/.

During the project, datasets have been available on a need-to-know basis only to those project participants or consortium members, who have been accredited by and whose data usage has been approved by the Principal Investigator or other authorised project consortium member.

The project participants will be responsible for curating, preserving, disseminating, and deleting in appropriate manner the datasets in their possession. Retention time for curated datasets will be the same as for other project results.

The data collected or acquired within the project has been stored in secure systems, such as Microsoft Teams for business IT environment behind a firewall or in a secure cloud environment provided by VTT's authorised and security-cleared IT service providers. Access to these platforms need registration and multifactor authentication from their users. A responsible project participant at VTT has been checking the requests to access to project's Teams channel. When access is granted to research data, it will be provided through secured telecommunications channels. The General Data Protection Regulation (GDPR, Regulation (EU) 2016/679 of the European Parliament and of the Council) will be followed when storing and transferring sensitive or personal data.

Because SSbD data is complex and different items are related, the ELN approach was introduced early 2025. FAIR database eNanoMapper or similar system has been utilised to store research metadata. The personal data collected from the interviews has been made accessible to consortium members strictly on a need basis.

Data security has been ensured according to national legislation, and the members of the consortium operating the data have been and are responsible for fulfilling these requirements. Long-term and secure preservation of published research data will be ensured by using only certified and OpenAIRE guidelines compatible repositories.

Personal data received from the users has been treated confidentially, always complying properly the provisions contained in the GDPR and any other current norm that may be promulgated on the subject in the future.

Experimental data from partners to support computational modelling has been collected. This has been done through harmonised data entry templates (shared on project Teams server), which have been subsequently submitted to a FAIRification process (Kochey, 2020), and imported into a FAIR database (Jeliazkova, 2021). The database has role-based security and implements standard authentication protocols as OAuth2. The database access (web based) has been granted to partners requesting access. API access plans, using Oauth2 or API keys, are provided to software developers. The ELN at https://elab.zerof.adma.ai/ is protected with the same technology and with the same credentials as for the project database.

During the project, WP2, WP3 and WP4 have stored all relevant data to the dedicated Teams folders to ensure that the needed information has flown within technical work packages. In addition, data has been stored in selected format that has ensured that SSbD (WP6) and modelling (WP5) work packages have been able to utilize the relevant data in their work and thus being able to provide feedback for technical work packages. The ELN at https://elab.zerof.adma.ai/ is an attempt to introduce a structured approach for SSbD data organisation and storage.

7 Ethics

The privacy of data subjects is be secured by following closely the GDPR. The project consortium has appropriate technical and organizational measures in place to carry out data protection during the project. VTT has an appointed Data Protection Officer who can advise on data protection questions when necessary. Processes that handle personal data have been designed and built with the GDPR principles at the core. Specifically, informed consent for data sharing and long-term preservation is always included in questionnaires dealing with any personal data.

Dedicated processes are implemented to safeguard and protect research data (e.g., using pseudonymisation or full anonymisation where appropriate), and use the highest possible privacy settings by default. No person or organisation involved have unintentionally be identified directly or indirectly in the datasets. Any indirect reference to sensitive personal information or e.g., lines of businesses, branches or industries have been removed and destroyed after the anonymised dataset has been checked and validated. After curation, no person-related data has been publicly available without explicit, informed consent, of the data subject and – if no full anonymization is required – publicly available data cannot in any circumstances be used to identify a subject without additional information stored securely in a separate place.

Project members have always retained unambiguous and individualised affirmations of consent from the data subjects, and the subjects have always had the right to revoke their consent at any time. During and after the end of the project, the project members will clearly disclose any datasets, which have been collected during the project and declare the lawful basis and purpose for their processing. In addition, project members will state how long the data in their possession will be retained and unambiguously declare, if it is being shared with any third parties or outside of the EEA. Data subjects of the project will have the right to request a portable copy of the data collected in a common format, and the right to have their data erased under specified circumstances. VTT employs a data protection (privacy) officer (DPO), who is responsible for managing compliance with the GDPR. Research integrity and ethical principles related to data collection and use are covered in detail in the ethics section of the Grant Agreement.

A separate public Deliverable D1.2 Ethics Plan has been submitted on M3 (March 2023). That deliverable covers ethics aspects of the ZeroF project in more detail.

8 Conclusions

The ZeroF project has established a robust framework for data management, ensuring that all research and administrative data are handled securely, efficiently, and in compliance with relevant regulations. By implementing structured workflows, harmonised templates, and FAIR-compliant databases, the consortium has promoted data integrity, traceability, and reusability. Risk management measures, including role-based access, multifactor authentication, and regular quality control, have minimised potential threats to data confidentiality and availability. The commitment to open science is reflected in the careful consideration of data sharing and publication, balancing transparency with the need to protect sensitive information. As the project concludes, these practices provide a strong foundation for the long-term preservation, accessibility, and responsible use of project data, supporting both current and future research actions.

Co-funded by the European Union

Also funded by the Swiss State Secretariat for Education, Research and Innovation (SERI).

9 References

EC, 2021: Horizon Europe Data Management Plan Template Version 1.0. 05 May 2021

EC, 2016: General Data Protection Regulation (Regulation (EU) 2016/679 of the European Parliament and of the Council)

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Annex I Research Metadata Content

Project's metadata information will contain following headlines and it will be updated frequently. The collected content has been reported in the ENanoMapper database and several datasets in the ELN https://elab.zerof.adma.ai/.

General overview

- ID
- Work package
- Resource type
- Title
- Version
- Date of creation
- Creator
- Contributors
- File location
- Software used to create data
- Origin and method

Content description

- Description and relation to the project objectives
- Subjects (keywords)
- Geographical location
- Code list used
- List of variables
- Metadata schema used

Technical description

- Software used to create the file
- File format
- Necessary software
- File size

Sharing and preservation

- Use/Users
- Rights/Licence
- Dissemination
- Access
- Restrictions
- Repository for open data
- Permanent identifier (e.g., DOI, URN)