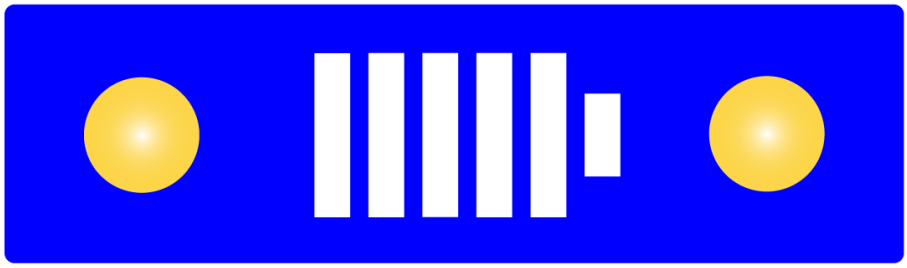

SPINMATE

Scalable and Sustainable Pilot Line based on innovative manufacturing technologies towards the industrialisation of Solid-State Batteries for the automotive sector

D1.2 Data Management Plan

SPINMATE project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101069712.

Document details

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Glossary and Abbreviations

WPL	Work Package Leaders
WP	Work Package
EC	European Commission
DMP	Data Management Plan
FAIR	Findable, Accessible, Interoperable, Reusable
SSB	Solid State Battery
WPL	Work Package Leaders

Contents

List of Figures

Executive Summary

The current deliverable is the first version of the SPINMATE Data Management Plan. It outlines how various types of data created with respect to the project activities will be handled during and after the project. This document describes how the data will be generated, stored, and processed and if and how the data will be shared among partners and/or made open. This document will be a reference for all SPINMATE consortium partners in implementing the defined measures and activities to achieve the project objectives.

1. Project Background

SPINMATE aims to demonstrate and validate innovative, scalable processing techniques and manufacturing solutions to scale up the production of Gen 4b SSB cells by 2025-2027, satisfying the demands of the EV industry towards GWh mass production. Technology innovations, with digitalisation playing a pivotal role, will be introduced along the value chain, focused on cost-efficiency, improved performance, enhanced safety, and increased sustainability. SPINMATE will also create a *broad knowledge portfolio* with the involvement of the main stakeholders and end-users (*electric vehicles* industry and entities interested in *stationary energy storage applications*) to maximize the impact of the project, as well as towards the future commercialisation of the project's solutions.

2. SPINMATE Data Management

2.1 Introduction

This initial Data Management Plan (DMP) describes the data management life cycle for all datasets to be collected, processed, and/or generated by the research project. During the project lifetime and across all work packages and activities, a massive amount of data is expected to be generated, collected, and treated. It will provide guidelines to define which data will be collected, processed, and/or generated, to what extent this data will be publicly available, and how data will be curated and preserved (during the project lifetime and after the end of the project too).

2.2 Data Management Plan objectives

This document will address three main points:

A. Data summary

This section will

- Specify the types and formats of data generated/collected
- Specify if existing data is being re-used (if any)
- Specify the origin of the data
- State the expected size of the data (if known)
- Outline the data utility: to whom will it be useful

B. FAIR data

Here, the DMP will provide some guidelines to which extent generated research data will be disseminated.

C. General data handling

In this section, we will spotlight the legal, ethical, and financial aspects related to the data management of the SPINMATE project.

The DMP will be a "living document" in which more detailed information can be made available through updates as the project implementation progresses. All additions/ modifications of the DMP will be provided to the project coordinator, ABEE, for insertion in the DMP.

In this regard, we will work closely with all the Work Package Leaders (WPL) to define and describe data sets specific to their work packages (WP). The WPLs shall formally review the data sets related to their WP when needed and at least by the first and second project periodic report to the European Commission (EC).

This plan is based on the template provided by the EC and will be updated and re-issued throughout the project as more information becomes available.

Keywords: Data Management Plan, work package, data

3. Data structure and storage systems

The exchange of data at different levels of the project (internal and external) will follow some guidelines elaborated below.

- Internal level: Between different work packages or institutions.
- External level: Between this project and other projects or clusters

A specific process will be defined for each exchange of data at the project's internal or external level.

3.1 Data storage systems

Internal level

Sharepoint

An online working space has been set up within MS Teams to enable communication, document management, and exchange within the SPINMATE partners.
This SharePoint comprises several folders with specific purposes (Figure 1). A folder per WP has been created to store all the documents related to the WP activities, tasks, and deliverables. Other folders may be created during the implementation of the action, as needed.
A list of quick links was created to facilitate access to the potential documents and files (Figure 2).
All the data collated or generated and registered on MS teams can be copied and transferred to a digital archive by the partners once the project ends.

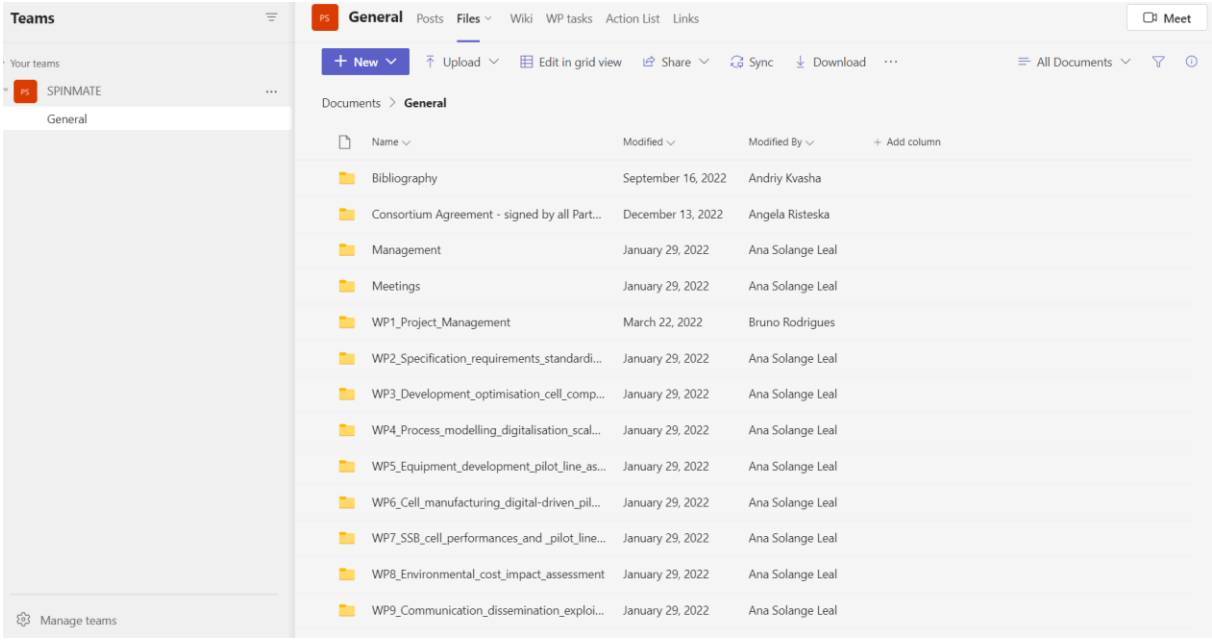

Figure 1 – SPINMATE SharePoint at MS Teams

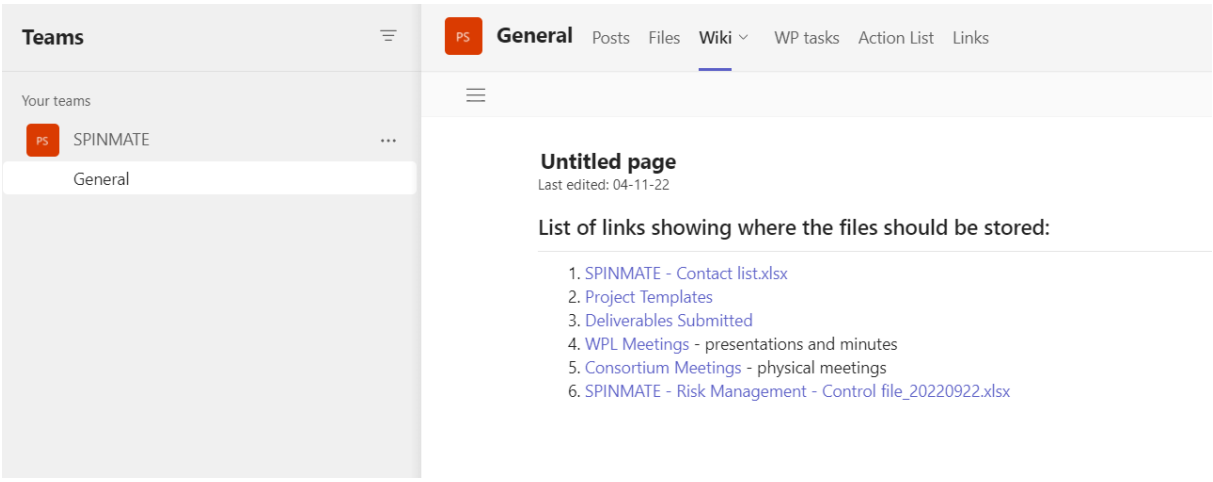

Figure 2 – Quick links at MS Teams

Website

The official website (https://www.spinmate.eu/) is one alternative to publishing and interacting with the community outside the project. Public deliverables, news, upcoming events, and collaborations will be published on the website.

Social media channels:

Social media is a valuable tool to target the general public and share public information regarding the SPINMATE project's achievements, news, upcoming event, and public deliverables.
A dedicated *Twitter* account (figure 3) (https://twitter.com/spinmate_eu) and a *LinkedIn* account (Figure 4) (https://www.linkedin.com/company/spinmate) are created for that purpose.

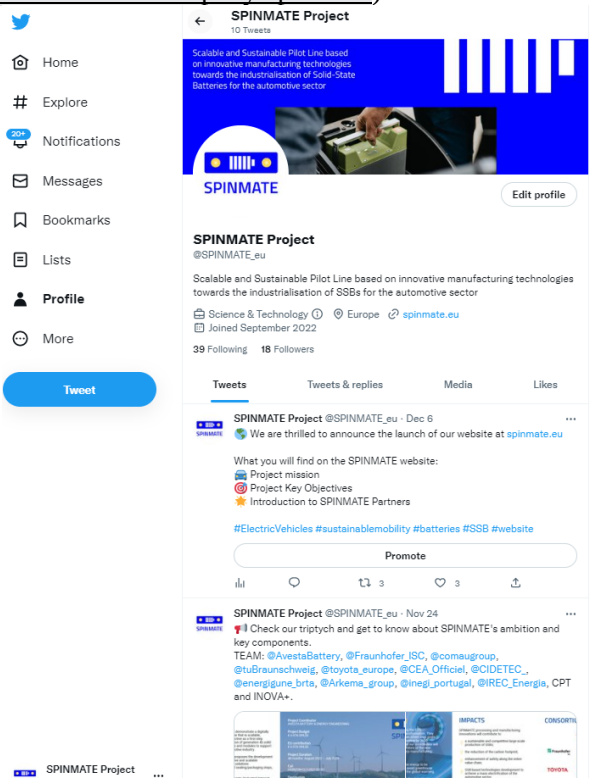

Figure 3 – Twitter homepage of SPINMATE

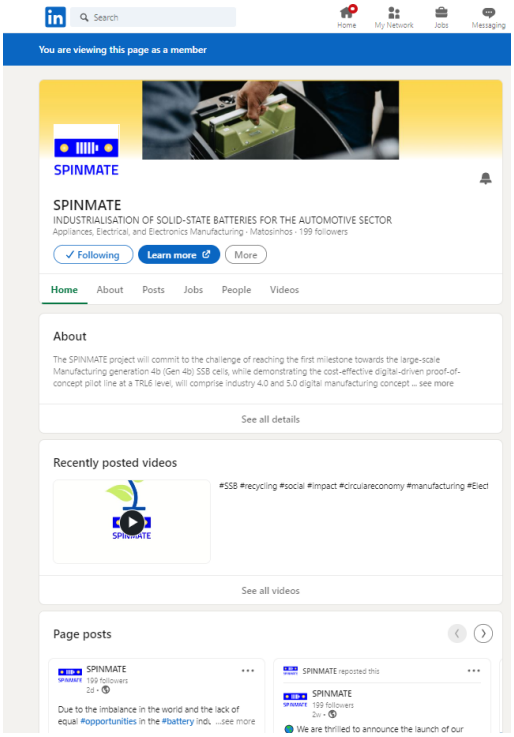

Figure 4 – LinkedIn homepage of SPINMATE

External level

As previously highlighted in the Grant Agreement, the SPINMATE project will be a part of some clusters under the **HORIZON-CL5-2021-D2-01-03** and **HORIZON-CL5-2021-D2-01-05 calls** (for instance, an MoU Has been signed with ADVAGEN). A memorandum of understanding will be signed to ensure effective and secure data-sharing between the involved projects in the clustering activities.

3.2 Data Summary

Since its start and with its nine work packages, the SPINMATE project is expected to generate a massive amount of and variety of data, for instance, experimental data, modeling data, processed data, etc...

Types of Data

Project Management and Coordination data: this data will be used internally in the management of the project. It includes summarized data to be presented in project meetings (agenda, presentations), project reports, partners' contact information, and project deliverables (public and confidential).

Experimental data: all the data and research outputs will be generated by following specified protocols and procedures that will ensure the reproducibility of research outputs.

Derived data: the data resulting from the data processing and analysis.

As agreed upon between SPINMATE consortium members, some standard formats are used for daily work and internal exchange between WPs or partners belonging to the same WP, for instance, presentations, contact lists, or schedules. This list includes mainly the following standard file types:

- Text documents (.txt)
- Adobe Acrobat Portable Document Format (.pdf)
- Microsoft Office Word (.docx)
- Microsoft PowerPoint (.pptx)
- Microsoft Excel (.xlsx/.xlsm/.csv)
- HTML

While pdf is the standard and recommended format for exchanging documents, it is also permitted for partners to exchange editable documents such as PowerPoint or Excel, especially for meetings.

Other documents, such as deliverables or scientific publications, are not covered in the data types above.

Data referencing

As previously discussed in the D1.1 "Management Handbook", naming and numbering the project documents should be done consistently to identify the project, document type, and version. The date should be used to identify a document version with the format YYYYMMDD.
Name segments should be separated by "_" and the acronym of the project that identifies the project should be included. For example, the draft version of Deliverable D1.1 produced on 31st August 2022 would be SPINMATE_D1.1_20220831_V01.doc. When sharing a revised document, the partner that has provided suggestions and inputs should include its acronym before sending the new version to the remaining partners: SPINMATE_D1.1_20220831_V01_ABEE.doc. When the document is in its final version, then the naming should be SPINMATE_D1.1_YYYYMMDD_INOVA+.doc

4. FAIR Data

As mentioned above, WP leaders will be involved in creating and updating the DMP during the project's lifetime. In the following section, we will discuss what they intend to do to make data findable, openly accessible, interoperable, and reusable, per WP, following the indications provided by the EC in [1].

5. DMP for WPs

5.1 DMP for WP2

WP2 Data summary

WP2 aims to first define general requirements for cells developed within SPINMATE based on: different needs from the final customers (i.e., driving range), different preliminary performances of each material (i.e., active material capacity, electrolyte, and catholyte's conductivities), composite electrode ratio (i.e., wt% of active material, wt% of electronic additive and wt% of catholyte) thickness of different parts (i.e., positive composite electrode, negative electrode, and solid electrolyte layer) and then elaborate KPIs that need to be fulfilled by prototype (1Ah and 10 Ah) cells built within SPINMATE. Secondly, WP2 aims to harmonize test protocols that will be used to evaluate cell performances within SPINMATE based on an international standard such as IEC 62660-1.

WP2 Data type

Data generated in WP2 will mainly be tables where different parameters such as active material capacity, composite electrode ratio, the electrolyte layer, and composite positive electrode thicknesses will be estimated to forecast possible volumetric energy densities (Wh/l), and gravimetric energy density may be achieved (Wh/g) by cell within SPINMATE.

WP2 FAIR data

To easily share these data, they will be combined in an open-source script such as a Python file (.ipynb) and shared in the appropriate folder on TEAMS SharePoint.

5.2 DMP for WP3

WP3 Data summary

WP3 aims to optimize and produce the different components of the cell and define the final cell configuration that will be transferred to WP6 for scaling up. More specifically, the WP3 objectives are: (i) to optimize and supply high-capacity Ni-rich layered oxide active material; (ii) to develop and synthesize a solid polymer electrolyte; (iii) to develop a Li metal-coated Cu foil negative electrode; (iv) to develop and optimize the formulation of the solid electrolyte; (v) to develop the positive electrode; (vi) to scale up the production of cathode active material. Several sets of materials, electrodes and electrolyte layers, and cells will be prepared and characterized by physicochemical and electrochemical characterization to achieve these objectives.

WP3 Data type

Different types of data will be generated, e.g., databases (for sets of materials, electrodes, cells, etc.) in the form of Excel or Access files, experiment raw data (exported text files), data analysis files (Excel, Origin, etc.), images (for instance for SEM measurements), etc.

WP3 FAIR data

The partner producing the data will store the raw experimental data and analysis files. These data could be shared among partners, upon reasonable request, through the project Sharepoint, if needed. It will depend on the confidentiality conditions set for each dataset. The main results will be provided to partners as Powerpoint presentations and reports.

Datasets whose confidentiality condition is set as “public” (for example, after the publication of a scientific article) may be shared through an open repository such as Zenodo, in case public sharing is valuable. In any case, published data shall not contain sensitive information compromising the partners' intellectual property.

All publications arising from the activities of this project will be published according to the gold publishing model, either in OA journals or the OA model in subscription-based journals. Any data that can be shared via public repositories will be fully accessible without restrictions and in compliance with the Grant Agreement (GA). All project partners that provide information for the datasets will be able to access the data in accordance with the GA. Additional search keywords will be added to data collections in public data repositories to increase findability (e.g. Zenodo). In scientific publications, data will be concisely described in a way that makes the results easily reproducible. A DOI will be assigned to each published article by the corresponding journal.

5.3 DMP for WP4

WP4 Data summary

The objective of WP4 is to develop mathematical models of the single process steps and to elaborate new algorithms to detect correlations between process parameters. Models and algorithms will constitute tools that can be used to optimize the manufacturing process and improve cell quality. To this end, the activities foreseen in WP4 are: (i) execution of experiments and collection of relative data; (ii) elaboration and validation of mathematical models of the process steps; (iii) development of ML algorithms; (iv) simulation of a large-scale manufacturing environment.

WP4 Data type

WP4 will have to handle a large amount of data from both physical experiments and simulations. The data obtained from experimentation will have the formats described in this document's analogous paragraph related to WP3 and WP7. For WP4The data coming from simulations will have the following formats: txt, xls, csv. While the db format will be used for data coming from models of the large-scale manufacturing environment developed for the Discrete Element Simulation (DES).

WP4 FAIR data

To make the data coming from experiments easily to be consulted and operated by model developers, they will be all converted in a single standard format, which the WP4 partners will choose between xls and txt. Moreover, the files will be adapted to follow other standards defined within WP4, referring, for example, to a standard unit of measurement taken as a reference. This will enable the creation of tools that can handle standardized data in both input and output.

A legend will be provided reporting the main information of each datum, for example the sampling frequency, the unit of measurement, etc. This will make easily readable and interpretable the data files.

The data will be shared among partners through the internal repository – TEAMS SharePoint, in the folder dedicated to WP4. Two separated sub-folders will be created, one for the experimental data and the other for the simulation data. The folder dedicated to simulations will be further divided into sub-folders “Input” and “Output”, reporting the data used as input and those generated as output of the simulations.

To make the files easily findable, a common file name will be adopted for experimental and simulation data. The standard title will have the following format: YYYY-MM-DD_ PROCESS-NAME_TRIAL#_PARTNER-NAME.

5.4 DMP for WP5

WP5 Data summary

This WP aims to modify and optimize the manufacturing equipment to ensure the up-scalability of cell production. Therefore, the data within this work package regards mainly equipment modifications and potentially the collection of data derived from the implementation of the selected digitalization approaches.

WP5 Data type

The data to be recorded within this work package will be, on the one hand, a list of the modifications/added features carried out in each tool. To do so, an Excel (.xlsx file) will be created and shared with the partners involved in the specific task to track each tool's status, modifications done, and when these were done. If data is generated to check-up that the tool is working correctly (e.g., data derived from a calibration experiment), the excel file will indicate where this data can be found.

WP5 FAIR data

At the start of this work package, a word document will be created with the input of the partners involved in this WP to specify where and how the data will be stored within Sharepoint.

For instance, a modifications tracker will be used.

A specific agreement will be reached at the start of this WP regarding the naming of files, and the guidelines based on the “Management handbook" then will be shared in the WP5 folder within the SharePoint of the project.

5.5 DMP for WP6

WP6 Data summary

This WP aims to design and scale up the production processes of large-format SSB cells by scalable and industrially relevant based on the results from WP3. It includes the production of the raw materials (cathode active material and polymer solid electrolyte), the cathode layers, the solid electrolyte (separator) sheets, and the (coated) Li anode. The aim is to produce multilayer pouch cells up to 10 Ah initial capacity.

WP6 Data type

Similar to WP3, different types of data will be generated, e.g., databases (for sets of materials, electrodes, cells, etc.) in Excel form or Access files, experiment raw data (exported text files), data analysis files (Excel, Origin, etc.), images (for instance for SEM measurements), etc.

WP6 FAIR data

The partner producing the data will store the raw experimental data and analysis files. If necessary, these data will be shared with WP4 or could be shared among partners, upon reasonable request, through the project SharePoint.

Datasets whose confidentiality condition is set as “public” (for example, after the publication of a scientific article) may be shared through an open repository such as Zenodo.

5.6 DMP for WP7

WP7 Data summary

In WP7, SSB cell performances and aging, and SSB cells and pilot line safety are assessed. Many experimental tests and analysis will therefore be done in this work package, according to procedures that will be defined in the project. A safety evaluation will also be done.

WP7 Data type

The main hypothesis for the tests, the synthesis of the results and the safety analysis will be gathered in the work package deliverables. Additionally, the author, the details of the test conditions (date, environment, etc.), the tested products, and the results files will be stored for each test. Test files can contain, for instance, the temporal evolution of the parameters of a cell during the test (voltage, current, temperature, pressure, etc.). They can also be analysis results (pictures, curves, etc.).

WP7 FAIR data

During the project, the rule to name the experimental shared files and how they are arranged on the Sharepoint (ex: data can be arranged by work package / task, then organized by test or analysed product.) will be defined.

Because the complete raw files of the experimental tests can be huge (ex: ageing tests, on a long duration), the partner in charge of the test will be responsible for its raw data storage. Nevertheless, at least synthesis files containing the main results will be shared on the project Sharepoint, according to the confidentiality conditions defined for each data. The name and storage location of the raw files will also be communicated for traceability, even if raw files are not systematically shared.

5.7 DMP for WP8

WP8 Data summary

WP8's primary goal is to analyse and characterize the developed technologies' environmental and economic performance in SPINMATE, to support decision-making during the design phases. To do so, a digital data platform will be developed, where data from WP3, WP4, WP6, WP7, and WP8 (recycling activities) will be gathered regarding the main inputs and outputs of mass, energy, and costs for the manufacturing line, the SSB cells, and the recycling processes. The information will be sorted and organized in the digital platform to provide robust life cycle inventories. The results will be the main environmental impacts of the developed technology processes in impact categories such as Global Warming, Ozone Depletion, Acidification, Water footprint, and others. Recycling activities will focus on developing a recycling process for critical material recovery from the SSB cell.

WP8 Data type

The type of information handled in WP8 will consist of material quantities and characteristics, supplier data and invoices, as well as process efficiencies, waste generation, performance indicators, emissions, water consumption, material recovery and others to conduct the life cycle assessment studies for environmental and economic performances, as well as the recycling process development. The inventories created in the platform will be able to be exported in .csv (between 1 to 10 GB). Data handling and results will be handled in .docx, .pdf and .xls. Other representations of the main flows may be created in .jpg.

WP8 FAIR data

During the creation of life cycle datasets in the platform, metadata will be generated automatically in .txt format, containing the previously described information regarding the data inserted, as presented in the following example: Title of the metadata file; YYYY_MM_DD_HH_MM_SS_USERNAME_NAME OF DATA.txt Information inside:

- Name of data;
- Creator;
- Date of creation;
- Description; SOPs;
- Data-specific information (if applicable)

Metadata will describe how the data were collected (experimental conditions and settings described in Standard Operating Procedures (SOPs)) and processed (software/code). Each set will have at least: title, date of creation, creator(s), description, SOPs, and (if applicable) data-specific information. Data that will be shared via public data repositories, such as Zenodo, will receive a Digital Object Identifier (DOI) and metadata recorded during the project will be provided there.

Before accessing the data management platform, partners will accept the handling of information, in which any data deemed sensible, and thus confidential, will not be visible to other partners, only for INEGI to conduct the assessments. The datasets created will be published, with the retraction of such sensitive information to protect partners' intellectual property. In addition, the published results will be aggregated to ensure that no reverse engineering is possible.

All publications arising from the activities of this project will be deposited in institutional or thematic repositories (Zenodo) and will be published according to the gold publishing model, either in OA journals, or the OA model in subscription-based journals. Any data that can be shared via public repositories will be fully accessible without restrictions, and in compliance to the Grant Agreement (GA). All project partners that provide information for the datasets will be able to access the data in accordance with the GA. Additional search keywords will be added to data collections in public data repositories to increase findability (e.g. Zenodo). In scientific publications, data will be concisely described in a way that makes the results easily reproducible. A DOI will be assigned to each published article by the corresponding journal.

5.8 DMP for WP9

WP9 Data summary

WP9 aims to develop a good communication and dissemination strategy, providing the project with attractive identity communication tools fostered by open science best practices. SPINMATE partners will disseminate the project and its results, fostering cooperation and interaction with relevant initiatives at the EU, national and regional levels. Thus, communication materials (including flyers, posters, videos, etc.) will be developed to support the project's dissemination, made freely available online at the project website and social media channels, and disseminated accordingly during events.

WP9 Data type

Communication, Dissemination, and Exploitation activities in SPINMATE require developing different materials. The creation of materials includes the project branding material with

logotypes and banners (.png, .jpeg), marketing materials with project presentations, and videos (.ppt, .mp4). Final versions of the communication material will also be available in .pdf to facilitate the sharing and avoid errors in documentation format when accessing the documents using different operating systems/software.

WP9 FAIR data

Communication materials will be made available to the project partners in interoperable formats directly on the TEAMS project channel. The large public will easily identify and access the materials on the project website and social media channels.

6. Allocation of Resources

The data collection and storage costs fall within the activities covered by the current grant. The responsibility for managing data underlying SPINMATE activities will lie with the partners leading the respective work packages and tasks and the authors of the individual research studies or deliverables.

The European Commission funds Zenodo through the Open Aire projects, so it does not bear costs associated with long-term storage and preservation of data deadlines.

All SPINMATE partners are involved and responsible, in one way or another in data management. Under the supervision of the Coordinating Institution (ABEE), all respective partners play a significant role in ensuring that the data management provisions are applied.

ABEE will oversee data management, while quality control of each dataset in a WP is the responsibility of every WP leader. Informed consent (including long-term preservation or data sharing) in data collection and information protection in data storage and access will be considered as well as procedures for the long-term preservation of datasets during the project and up to 5 years after. All WP leaders will design a suitable tested backup strategy to allow full recovery of the locally stored data. SPINMATE data will be deposited, made available, and shared with investigators in the same research area.

The responsible team members are:

- Responsible for the collection of the data: be defined later
- Responsible for the processing and preservation of the data: be defined later
- Responsible for backups: Marco Duarte (INOVA+)
- Responsible for publishing and sharing data: be defined later
- Responsible for DMP creation: Takwa Benissa (ABEE)
- Coordinator of Open Access: Ana Rita Araújo (INEGI)

7. Data Security

HYPOBATT project will undertake all required efforts to protect the data, products, and services against unauthorized use.

However, the primary responsibility to take necessary measures to ensure data security lies with the partners. All shared, processed and operational data will be stored in secure environments at the locations of consortium partners with access privileges restricted to the relevant project partners. If (processed) data is to be transferred from one partner to another, the transfer needs to be done securely, for example, via a secure data channel. Yet, using SharePoint is recommended.

Once data are stored on the web-based repository of the project (SharePoint), the security provisions come from there.

The following guidelines will be followed to ensure the security of the data:

- Limit the work on remote files and exchange of collaborative documents – whenever possible, the work should be done online;
- All deliverables are developed and reviewed online to avoid loss of data;
- Encrypt data if it is deemed necessary by the participating partners when applicable;
- Label files in a systematically structured way to ensure the coherence of the final dataset.

All servers are protected against unprivileged access per current standards and include firewalls and authentication. Routine data backups are performed.

8. Ethical and Legal Aspects

Regarding ethical aspects, no ethical issues may arise from the research activities to be carried out in SPINMATE.

For legal issues, data sharing is regulated as indicated in the Grant Agreement and by the Consortium Agreement signed by all the beneficiaries taking part in the project. Therefore, while sharing data and/or making data accessible, data will be needed to be carefully reviewed to ensure that the communication and dissemination plans established for each data set do not raise any confidentiality issues.

9. Ethical Aspects

SPINMATE activities will be conducted according to national legal and ethical requirements of the countries they take place in, namely, Belgium, Germany, Italy, France, Spain, Portugal, and Norway. Furthermore, SPINMATE will comply with Horizon 2020 (and further) ethical standards and guidelines and with the provisions of the General Data Protection Regulation 2016/679 for the collection and processing of personal data in meetings, communication, and dissemination activities.

The ethical guidelines are the following:

- Honesty in collecting and processing scientific data;
- Transcription and careful analysis of scientific results to avoid inaccuracies;
- Independent analysis and interpretation of results based on credible data and renown sources;
- Open sharing of methods, data and interpretations on public deliverables;
- Adequate validation of results through replication and peer collaboration; and
- Moral obligations to society in general.