REMTES

TECHNOLOGY FOR REMOTE TEMPERATURE MEASUREMENTS IN MICROFLUIDIC DEVICES

PROGRAM-PRIZMA-2023-2026

Grant Agreement: 7017

Deliverable 4.2
Data Management Plan
Version 1

Project Deliverable Information Sheet

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1. Introduction & Context

REMTES – "Technology for remote temperature measurements in microfluidic devices" is a Science Fund of the Republic of Serbia funded project (Program PRIZMA, Grant Contract No. 7017) coordinated and completely executed by "Vinča" Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade (VINS). The project will run from December 1st 2023 to November 30th, 2026.

REMTES is a highly ambitious and innovative project aimed at developing a breakthrough system for measuring sample temperatures on the nanoliter scale. The project will develop an optical self-referencing thermometer for use in micro- and nanofluidics in the 0–100 °C temperature range by exploiting temperature-induced changes in the luminescence of materials and nanomaterials; that is, by advancing luminescence (nano-) thermometry in a targeted manner. The project aims to go beyond the state of the art and implement a radically new technology that merges the fields of luminescence thermometry, photothermal spectroscopy, and microfluidics to develop new-generation luminescent thermometry probes using cutting-edge luminescent, temperature-sensitive, and chemically stable inorganic materials in bulk and nanomaterial forms. The probes will be embedded in microfluidic chip channels to enable self-referenced remote temperature measurements, and the technology will be validated by a portable microfluidic luminescent thermometer, as well as in-situ temperature measurements of fluid flow in nanoliter volume samples. Multiple conceptual breakthroughs can be further envisaged from the proposed technology credibly spreading its impact to multiple technological areas.

The present document – D.4.2 Data Management Plan (DMP) is a deliverable of the REMTES project, and it is in accordance with articles 28 and 29 of the Contract for the financing and realization of the project between the Science Fund of the Republic of Serbia and "Vinča" Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade, No. 4958/2023 (Contract). It follows recommendations on "Open Access to research data" and is consistent with exploitation and intellectual property rights requirements. It is expected that all members of the REMTES project team bind to this document and follow the guidelines and procedures hereby described.

Thus, we refer to the Contract articles 28 and 29 about open access to research data:

> **"article 28"**
> *Publication of papers in leading scientific journals, including open science journals, and presentation at leading scientific conferences is suggested.*
>
> **"article 29"**
> *In order to increase the quality and visibility of the results of scientific work, the Principal Investigator is obliged to ensure that the research within the Project is carried out in accordance with the principles of open science, and that accordingly:*
> *1. at any time during the duration of the Project, as well as at least one year after the end of the Project, provide interested parties with access to the results of the Project, in accordance with good academic practice, intellectual property rights protection, and data protection;*
> *2. ensure that the primary research data collected during the implementation of the Project are prepared, systematized, structured, and electronically formatted. It is recommended that open access to such data be provided in accordance with the law governing the field of science and research, and according to the recommendations and guidelines of the Science Fund.*

2. Data Summary - Purpose, Features and Principles

A Data Management Plan (DMP) is a key element for good data management. The purpose of the DMP is to do an analysis of the main data collected and generated in the frame of the REMTES project and to design policies and provide a strategy for managing those data to optimize access to and re-use the same. It will cover the complete research data life cycle (Figure 1). In particular, the document describes the types and formats of research data that will be generated or collected, the standards that will be used, how the research data will be preserved and/or what parts of the datasets will be shared for verification or reuse.
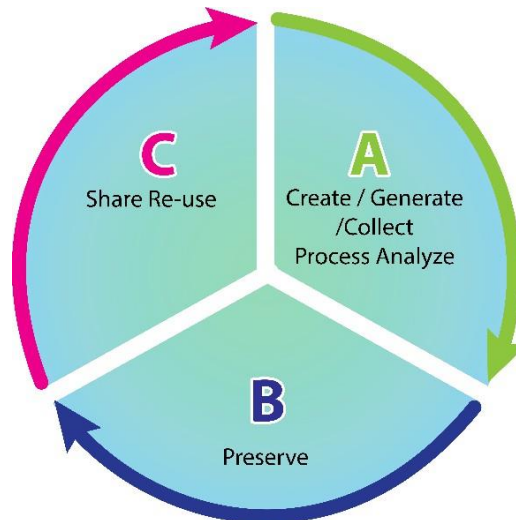
Figure 1. Research Data Life-Cycle

The data generated by REMTES can be related to the data management life cycle as follows. Raw data will be generated/collected from lab work, simulations, analysis, and measurement and these will be processed and worked into more suitable and usable forms (reports, publications, data tables, images, etc.) (step A, Figure 1). Then, there is the need to preserve that data, which implies appropriate naming rules and metadata schemes (step B, Figure 1). An Open Access policy will be applied to define which datasets will be made accessible (share and re-use, step C, Figure 1).

Due to its nature, REMTES DMP is not expected to be a fixed document, it will rather evolve during the project's lifetime and, therefore, it will be reviewed and updated at regular intervals. Situations that oblige a revision of the DMP are (but not limited to): new data, changes in the project policies (innovation potential, decision to file a patent, etc), changes in the project composition, etc. If necessary, it will be updated in month 24, which corresponds to the periodic yearly report to the Fund.

This first version of the document includes preliminary information on the datasets to be produced and/or collected by the project, their nature, and some of the specific conditions that are linked to those datasets (at least, the ones that are identifiable to date):

Scientific knowledge (*data and publications*) produced during the project will be available through **open access** (*data and publications*) **or subscription** (*publications*) schemes. The papers will **primarily** target journals categorized as **M21** in the Republic of Serbia and offering **open access publication** or grant self-archiving (e.g., Nature Materials, Nature Communications, Advanced Materials, Advanced Optical Materials, Nano Letters, Nano Research, Nanoscale, Ceramics International RSC Advances, MDPI publisher) according to recommendations of the Budapest Open Access Declaration (the use of CC BY liberal licensing). In some cases, a CC0 license (completely in the public domain) may be provided. **Open-access publications** will be available through the project website and the website of the Optical Materials and Spectroscopy Group (https://omasgroup.org). They will be deposited on Zenodo, which is a catch-all repository for research provided by CERN, (an OpenAIRE partner), completely free to access and does not require an account. **Open data management** will also be implemented. While not compromised by the exploitation strategy, the data generated during the project (measurement, simulations, etc.), and the necessary accompanying information, will be publicly accessible on Zenodo via the project's website, after publication in peer-reviewed journals (both **open access and subscription)**.

The next versions of the DMP will be amended or corrected where needed.

The present document is based on the template made available by the European Commission (EC) "Template Horizon 2020 Data Management Plan (DMP)" [1], with adaptations. Also, it has been produced following the EC guidelines for projects participating in FAIR Data Management. In general, FAIR data management implies that research data should be Findable, Accessible, Interoperable and Re-usable (Figure **2** [2,3]).
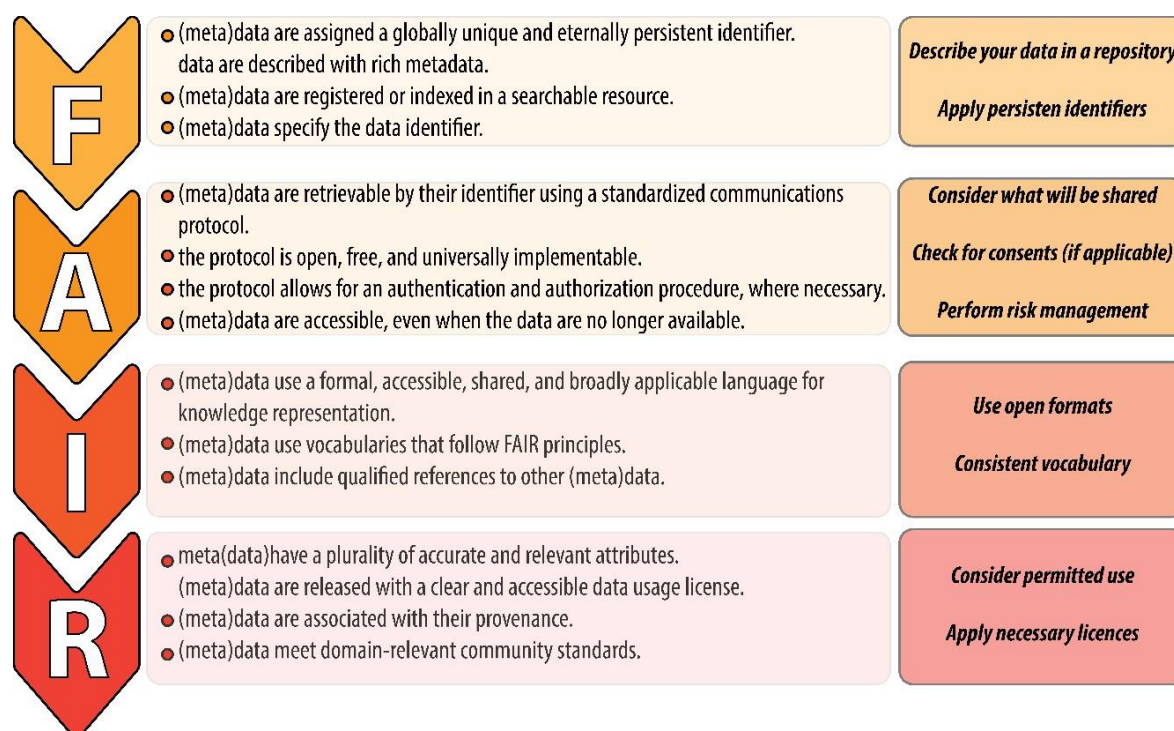

Figure 2. FAIR Data Management Principles (adapted from [2] and [3]).

3. Data Summary - REMTES Data Sets

The datasets collected/generated by REMTES can be categorized in 2 main types/categories: **I. Research Data and Metadata and II. Publications and other dissemination materials**. In this regard, and depending on the type of the dataset, there are several standards and guidelines the project needs to be aware of and follow, which will be addressed below.

Per principle and following the Contract (article 29), research data linked to exploitable results will not be put into the open domain if they compromise commercialization prospects or have inadequate protection. The rest of the research data will be disseminated using an open-access repository (Zenodo). This will be scrutinized by the PI and project management staff, with the help of the support structures (e.g., the Office for the Project Management of the Vinca Institute of Nuclear Sciences and the Library). In any case, the analysis and decision on these matters will follow the guidelines shown in Figure 3 [3,4] widely accepted in EU Horizon projects. In practice, compliance with Article 29 and the formerly mentioned guideline will mean that for any of the project findings, that are highly innovative and/or have a high possibility for commercialization 2 actions will be taken: 1) withhold the data for internal use or 2) ensure the correct protection (e.g., apply for a patent application, trademark registration, etc.) and initialize technology valorization efforts to find a possible licensee. Additionally, in this context, additional measures will be taken, namely the application of non-disclosure agreements whenever information is to be shared outside the project team and/or publication delay so that patent applications can be filled. Otherwise, the research data will be available for Open Access by primarily publishing in journals adhering to Open Access policies (green or gold) and using online repository services (*research data connected to both Open Access and Subscription journals*).
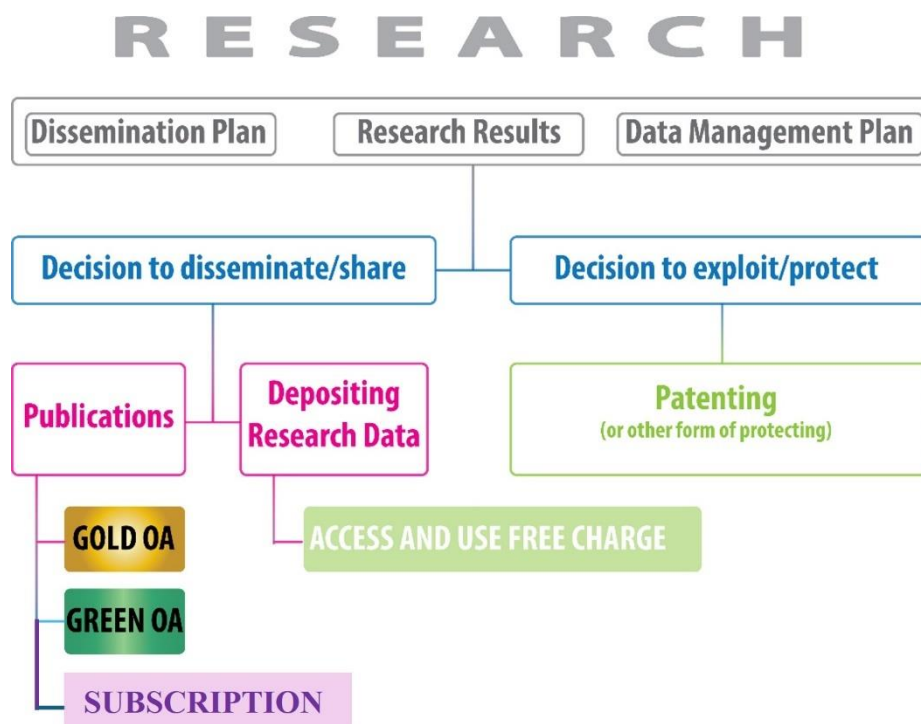
Figure 3. Access to scientific publications and research data in the wider context of dissemination and exploitation ([3,4]).

The data generated refers to the experimental and technical data generated/collected during the project execution. Datasets will be generated mainly in the form of spreadsheets, tabulated text files, image files, and programming code. Regarding dataset size, at this point of the project, we cannot estimate the total amount of data generated during the project.

In Table 1 is listed a summary of the data format generated/collected by REMTES project members. A complete detailed list of data type formats is **in Annex 1.**

File Type	Format
Datasets	".xls", ".dat", ".doc"
Images	".png", ".jpg/jpeg", ".tif/tiff"
Code	".m", ".nb", ".vi"
Other	".pdf", ".zip", ".rar"

Table 1: Summary of data formats used in REMTES

The data collection generated by REMTES will be used, in the first instance, by the project members and VINS, subsequently; the results/findings/developments obtained by the REMTES project may be useful to scientific or private entities.

The data sets can be identified and detailed as follows (according to FAIR Data principles) (presented by material type data set).

This table will be used for each dataset

Data set reference and name	*e.g., Materials_DataSet;* *e.g., Colloidal-Thermometers_DataSet;*
Data set description	The metadata will be recorded in a *.xls* file comprising the data collection, describing the following key aspects: - *Project name* - *Funding source* - *Data researcher* - *Sample name* - *Sampling procedure* - *Data collection instruments* - *Substantive, temporal and geographic coverage of data collection* - *Data source(s)* - *Variables* - *Technical information on files* - *Citations to related publications (if applicable)* - *Technical information on files, e.g., information on file formats, file linking*
Metadata and Standards	Metadata: The metadata generated for each data set or image, will be organized according to the corresponding fields existing in Zenodo.org: - *Digital Object Identifier* - *Publication date*

	- *Title* - *Authors and affiliations* - *Description* - *Keywords* - *Access right* - *License* - *Community* - *Grants* **Standards:** Data and metadata will be given in standard US English. Each data set will be accompanied by a description (field available on Zenodo.org) to identify contents and experimental conditions. Openly shared REMTES data will be identified according to the following guidelines: • Data related to a published research article will be named as follows: "First author name _ Article reference_ Figure number (letter)_version.extension" in which the article's reference will be stated as: "Standard Journal Abbreviation + issue number(year)page" and the version will be abbreviated as "v" and numbered in increasing order from less to more recent, starting by 1 with increments of 1 unit, e.g. "v1, v2, v3…". • For figures, tables or calculations involving or yielding an ensemble of data files, those will be shared within a compressed folder following the above stated naming convention, in which, the 'extension' will correspond to a standard compressed folder extension (e.g. .zip). In such cases, the name of the individual files included in the compressed folder will be freely chosen by the data owner, making sure that name repetition does never occur and that the content of each file is clearly described in a supporting text file. • Data from other sources, e.g. public presentations, posters, summary reports, etc. will be shared within a single compressed folder named as: "First author _ DOI Zenodo _version.compression extension" in which, the DOI given by Zenodo.org will be used to link the data to its source (e.g. conference poster).
Data sharing	The data generated by the project will be shared among the project members whenever necessary. A shared platform in the Zoho.eu website will be used to upload and share generated data to be used by the project team members. To whom it may interested in REMTES data can access the majority of those data (public) mainly through publications (Open Access Scientific Journals) dissemination materials and Zenodo.org. Raw and processed data will be openly accessible according to decisions from the project management team. REMTES data will be available through the Zenodo.org website. This is a catch-all repository for EC-funded research provided by CERN, an OpenAIRE

	partner. Zenodo.org does not require an account, login or password given free access to the deposited data.
	The Creative Commons Licensing will be used for all data deposited on Zenodo.org, protecting the ownership of each data sets.
	REMTES data will mostly be available for re-use as soon as possible. If the data are used in a publication or other, it will be deposited on Zenodo.org as the publication is public. The access to the data will follow the same embargo as the publication deposited on Zenodo.org.
	The unpublished data, after the decision by the Principal investigator, will be deposited in a data repository for a certain time also determined by the project team.
Archiving and preservation (including storage and backup)	Each REMTES team member is responsible for data quality since they are the data producers. In any case, the project follows the standard practices in physics and chemistry: reproducibility, reliable statistical analysis, noise/error bars evaluation, and consistency with other experimental results and theory. Zenodo.org server will allow the long term of data generated; at least as long as CERN is operating. If for some reason Zenodo.org closes, the migration to another repository will be guaranteed.
Reported by	The data set generator

4. Allocation of Resources and Responsibilities

Compliance with FAIR principles implies costs. These can be related, for instance, to Open Access publication, project website maintenance, use of repositories or copyright licensing. The table below lists some of the costs identified:

Publication in "Open Access journals"	Costs related to open access to research data in the PRIZMA Program (The Science Fund of the Republic of Serbia) are eligible for payment under the conditions defined in the Contract.
	In this regard, these costs were anticipated and considered in the project budget. The cost of sharing, in the case of multiple authors, will be decided among the authors on a case-by-case basis.
Project Website Operation	Supported by the project management team
Data archived at ZENODO	Free of charge
Other fees	As the project is responsible for the data it produces, any other fee will be the responsibility of the REMTES project.
Long-term preservation and storage	Data preservation for at least 1 year after the project ends is required.
	The final dataset will be transferred to the ZENODO repository, which ensures sustainable archiving of the final research data. Additional data storage will be ensured by the VINS data repository.

The VINS, the only institution involved in the realization of the project, will be responsible for DMP writing/updating/ coordination as well as, together with the REMTES project management team, monitoring its implementation, ensuring that all the project members comply with it. Each project member is responsible for the data it produces (data generation, metadata production, data quality, and proper data management), and should comply with the present deliverable and included guidelines.

5. Data Security

The REMTES approach for the sake of data security will follow the provisions listed below:

- Data should be stored in at least two different locations to avoid data lost
- Data should be encrypted whenever necessary (e.g. confidentiality issues)
- The use of USB flash drives should be limited
- Follow a systematic labeling procedure to ensure coherence through the datasets.

Data will be uploaded to Zenodo.org and stored in the CERN Data Centre. On the long-term storage, the institutional repository should provide a satisfactory level of security.

To date, no major issues regarding personal data security are foreseen.

6. Ethical Aspects

All the actions, protocols, and procedures related with REMTES project described are not subjects to any Ethic´s Directives and Rules delivered by the respective laws of the Republic of Serbia.

7. Other Issues

Details in relation to other national/funder/sectorial/departmental procedures for data management are not herein presented as this is a public DMP release.

8. Conclusions

The present DMP constitutes the first release of the REMTES DMP and is planned to be updated whenever significant changes arise. If necessary, it will be updated in month 24, which corresponds to the periodic yearly report to the Fund.

9. Bibliography and Sources

[1] European Comission, "H2020 templates: Data Management Plan v1.0," 2016.

[2] Force11 discussion forum, "The FAIR data Principles," Force11, [Online]. Available at: https://www.force11.org/group/fairgroup/fairprinciples. European Commission, "Guidelines on FAIR data management in Horizon2020," European Commission, 2016.

[3] European Commission, "Guidelines on FAIR data management in Horizon2020," European Commission, 2016.

[4] European Commission, "Guidelines to the Rules on Open Access to Scientific Publications and Open Access to Research data in Horizon 2020," European Commission - Directorate For Research and Innovation, Bruxelles, 2017.

10.   Annexes

Annex I

Data File Extensions

File ext.	Description	Editing software
dat	Generic data file	Text editors (e.g. Notepad)
txt	Text file	Text editors (e.g. Notepad)
doc	Text file	MS Word
xls	Spreadsheet	Spreadsheet software (e.g. MS Excel)
cvs	Spreadsheet	Spreadsheet software (e.g. MS Excel)
jpg	Raster image	Standard image viewers
png	Raster image	Standard image viewers
tif	Raster image	Standard image viewers
nb	Code	Wolfram Mathematica
xml	Code	XML editors
m	Cold	Mathworks Matlab
pdf	Portable document format	Standard PDF viewers
zip	Archive file format	Standard file archivers
rar	Archive file format	Standard file archivers