

# ERTMS on SATELLITE Galileo Game Changer

## D1.2 Data Management Plan

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## DOCUMENT APPROVAL

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## EXECUTIVE SUMMARY

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ERSAT GGC is an H2020 project that started under Work Programme 2017.

This document represents the Data Management Plan (DMP) of ERSAT GGC project that is part of the Open Research Data Pilot (ORDP), an approach set by the EC to foster accessibility and reuse of digital research data generated in H2020 projects under the terms and conditions set out in the Grant Agreement (number 776039).

ERSAT GGC partners are aware of the benefit of concept of open science to our society and committed to contribute to this value within the project.

This document has been prepared following the EC guidelines<sup>1</sup> that address research data quality, data sharing and data security.

The ERSAT GGC DMP describes the approach and methodology applied for the handling of data that is expected to be collected, analysed and produced during the course of the project.

The main aim of this document is to ensure that all data available in ERSAT GGC are FAIR (Findable, Accessible, Interoperable and Reusable).

This DMP is a living document outlining how the research data collected and generated within ERSAT GGC project will be handled during the development of the project activities and after the closure of the project.

The DMP is also a way to optimise the potential for future sharing and reuse of data.

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<sup>1</sup> "H2020 Programme Guidelines on FAIR Data Management in Horizon 2020", Version 3.0, 26 July 2016, EUROPEAN COMMISSION Directorate-General for Research & Innovation



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## 1. INTRODUCTION

This document constitutes the first issue of Deliverable 1.2 “D1.2 Data Management Plan (DMP)” in the GSA framework of the project titled “ERSAT Galileo Game Changer”.

This document has been prepared to describe the data management life cycle for all data sets that will be collected, processed or generated by ERSAT GGC project. It is a document outlining how research data will be handled during and after the project is completed. It describes what data will be collected, processed or generated and what methodologies and Standards are to be applied. It also defines if and how this data will be shared and/or made open, and how it will be curated and preserved.

The DMP is not a fixed document; it is to evolve and gain more precision and substance during the lifespan of the project.

According to “Grant Agreement 776039”, the first version of DMP is to be delivered in month 6 of the project. DMP is a living document and it will be updated by the Project Coordinator on the basis of the project needs. In order to maintain updated the DMP, during the project meetings, the Project Coordinator will insert in the agenda a session dedicated to the DMP, to be used to collect feedback and to further expand the list of data that ERSAT GGC project will make available.

The scope of the first version is to present an overall approach towards processing of the data produced within the framework of the project.

In Chapters 2-5, main objectives of ERSAT GGC and Data Management Plan are introduced. Chapter 6 will briefly describe the Cooperation Tool being the internal online storage platform.

The different categories of data together with the selection of open data, its preservation and data sharing are described in Chapter 7.

Chapter 8 finally explains the required resources and their related allocation.

This document should be considered complementary to other two ERSAT GGC deliverables “D1.1 Quality Plan” and “D7.1 Dissemination Plan” containing additional information and details on the data management defined and applied in ERSAT GGC project.

### 1.1 List Of Acronyms

Acronyms\Abbreviations	Description
DMP	Data Management Plan
EC	European Commission
FAIR	Findable, Accessible, Interoperable and Reusable
ORDP	Open Research Data Pilot
EGNSS	European Global Navigation Satellite System
EGNOS	European Geostationary Navigation Overlay System
ERTMS	European Rail Traffic Management System
STI	Standard for Technical Interoperability
LDS	Location Determination System
RINEX	Receiver Independent Exchange Format
EMI	Electromagnetic Interference
PLL	Phase-Locked Loop
DLL	Delay-Locked Loop



IF	Intermediate Frequency
RPS	Receive and Playback of Signals (equipment)
DOI	Digital Object Identifier
DoW	Description of Work

## 2. OBJECTIVES OF ERSAT GGC PROJECT

ERSAT GGC project is conceived for speeding up the certification process of EGNSS assets according to the ERTMS rules. It is a 24-month follow up of the ERSAT (ERTms + SATellite) EAV program launched in 2015 by GSA, technically led by RFI and Ansaldo STS for integrating satellite technologies on the ERTMS platform. Primary goals of ERSAT GGC are:

- i) to accelerate the standardization process at European level for including the satellite requirements into the new ERTMS STI (Standard for Technical Interoperability), by delivering a certified enhanced functional ERTMS + SAT architecture with proper functional and not functional test specification;
- ii) to define and test a certified standard process and tools for classifying track areas for locating virtual balises;
- iii) and to allow RFI, recently nominated Game Changer for integrating satellite technology into ERTMS, to launch an operational line by 2020, the same year Galileo services will be operational.

As a results of previous projects, EGNSS and ERTMS – both pillars of the European industrial policy - are becoming tightly intertwined and backed by a mutual-supportive business model - a pre-requisite to give birth to fast growing EGNSS applications and to the deployment of economical sustainable ERTMS solutions on local and regional market which today is dominated by legacy systems most of which old and still manually operated.

ERSAT GGC will rely on the achievements of the most relevant EC and GSA funded projects such as NGTC, ERSAT EAV, STARS, RHINOS, whose the individual coordinators are partners of the ERSAT GGC consortium.

The project will exploit a fully operational Test bed located in Sardinia on the 50km double track line between Cagliari and San Gavino. This Test Bed includes the ERTMS main constituents, a fully equipped train, and the EGNSS/ Wireless assets to operate with the ERTMS system based on the Satellite based Location Determination System (LDS). Other facilities, such as those of the CEDEX laboratory, DLR and RFI will be exploited for the certification process.

The ERSAT GGC consortium includes RFI, SNCF and ADIF as the main European rail stakeholders and two independent Notify body, Italcertifer and Bureau Veritas which are already supporting RFI for the certification process.

## 3. ERSAT GGC GRANT AGREEMENT



According to Article 29.3 “Open access to research data” of the ERSAT GGC Grant Agreement (GA N° 776039), all the ERSAT GGC beneficiaries must:

- a. *deposit in a research data repository and take measures to make it possible for third parties to access, mine, exploit, reproduce and disseminate – free of charge for any user – the following:*
  - i. *the data, including associated metadata, needed to validate the results presented in scientific publications as soon as possible*
  - ii. *other data, including associated metadata, as specified and within the deadlines laid down in the data management plan*
- b. *provide information – via the repository – about tools and instruments at the disposals of the beneficiaries and necessary for validating the results (and – where possible – provide the tools and instruments themselves)*

*This does not change the obligation to protect results in Article 27, the confidentiality obligations in Article 36, the security obligations in Article 37 or the obligations to protect personal data in Article 39, all of which still apply.*

*As an exception, the beneficiaries do not have to ensure open access to specific parts of their research data if the achievement of the action’s main objective would be jeopardised by making those specific parts of the research data openly accessible. In this case, the data management plan must contain the reason for not giving access.*

## 4. INFORMATION MANAGEMENT AND POLICY

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Information Management is the discipline by which information is managed within an organisation including acquisition, custodianship, distribution and disposal. Information Management and related Governance have emerged as key concerns for organisations in today’s environment of “Big Data” and increased data storage needs, Cyber Security and higher information risks, and greater compliance to regulatory and legal demands.

ERSAT GGC partners assumed that the data archiving for the project will be hosted within a cooperation tool external to any specific corporate Information Management System. However, the processes and the management of information are designed according to the Consortium Agreement [2], already signed by all the partners involved.

The Consortium Agreement regulates the ownership and transferring of results (§8), the access rights (§9), non-disclosure of information (§10) and the minimal measures of Cyber Security required (§11).

As a brief summary, the policies agreed foresee that results are owned by the Partner who generated them. In case the contributions are so interdependent that they are not separable, the partners will apply Consortium Agreement §8.2. Transferring of results were anticipated as much as possible, however the partner who wants to transfer results to other bodies has to inform the other partners in advance.



All the partners have access rights to the contents of the projects, and to all the background knowledge each partner has agreed to share upon signing (Attachment 1 to the Consortium Agreement). Access rights for Affiliate entities are regulated in §9 of Consortium Agreement. Confidential information communicated during the project shall be kept and managed as confidential for 4 years after the end of the Project. In the end, each partner shall ensure the security of the computer system used to perform the services and activities covered by this Consortium Agreement, including activities such as transmission, reception, retention and sharing of all documentation arising from the performance of this Consortium Agreement.

## 5. PROJECT DMP ORGANIZATION AND IMPLEMENTATION

ERSAT-GGC project is coordinated by RFI and managed through the Technical Management Team. The project has a structured governance and management framework that controls and directs decisions during the project. This is organised as shown in the figure below:

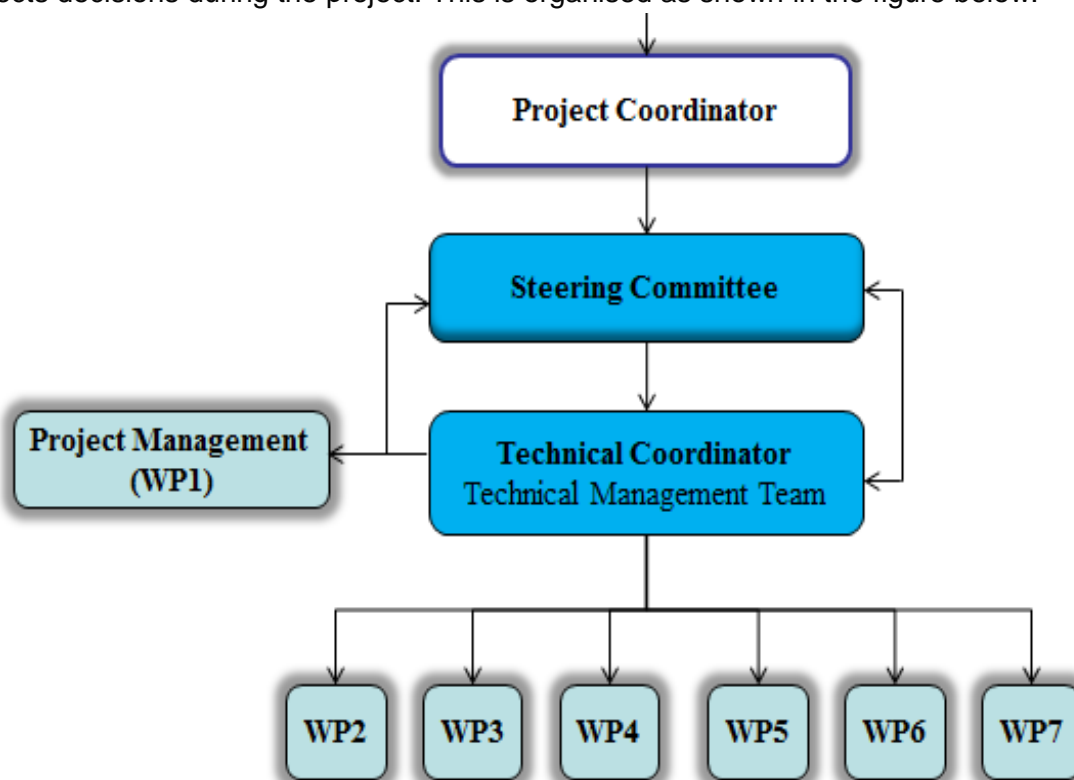


Figure 1 Organizational structure

The DMP is issued as project deliverable D1.2 under the work package 1, and will be administrated under the governance structure within the Technical Coordination as shown in the figure above.





## 6. ERSAT GGC DATA STORAGE AND BACKUP

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The storage and maintenance of data produced within ERSAT GGC project will be handled on a platform that offers services and support specifically in management of Horizon2020 projects. Cooperation Tool (<https://www.cooperationtool.eu/projects/>) - an easily accessible and user-friendly platform – aims at supporting the technical work of the consortium members and keeping track of activities that will take place within the whole duration of the project. In addition, the Cooperation Tool serves as a storage place of all material planned to be collected, generated or analysed throughout life of the project. Access to the content varies among beneficiaries and is provided based on partners' involvement in different WPs.

The main functions in Cooperation Tool – relevant for the data management are listed below:

- Data storage
- Exchange of data and information: upload and download documents (deliverables, minutes of meetings, agendas, presentations, Technical Annex, contact list, etc.)

## 7. ERSAT GGC DATA SUMMARY

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During the life of ERSAT GGC project, large amount of data will be collected and processed. In addition, new data is expected to be generated. Consortium foresees to collect, process and produce various categories of data.

Please note that list of data presented in the next chapters is not exhaustive and will be populated/adapted during the project development or in case needed.

The following three categories of data will be managed:

- Input data;
- On going data;
- Output data.

The project will exploit data coming from several previous projects about EGNSS applicability to ERTMS: those could be architectural designs and information, as well as requirements collected from different stakeholders in the Railway framework including the specifications and guidelines of ERTMS, provided by Railways international institutions (e.g. ERA, CENELEC, UNISIG). Those data will allow the synthesis and a final certified issue of the Functional ERSAT Architecture, which will be the reference for the new interoperable standard.

Data coming from tests on EGNSS quality of service, performed in the last years within all the related projects, and from the ERSAT GGC itself, will be the input for the severe hazard analysis required to certify the solution and to identify a migration strategy for upgrading existing ERTMS lines.

On going EGNSS and environmental data collected by track and lab campaigns in the frame of WP4 activities (Track Survey and Track Classification) will allow not only the definition of a standard procedure for track classification for locating the virtual balises, but they will be reusable by new projects to design and assess new features of ERSAT system covering EGNSS vulnerabilities.



Certifiable tests and results will be produced by WP6, generating data verifiable by European Railway and GNSS institutions and communities.

## 7.1 “FAIR” Data

All the data and metadata in ERSAG GGC will be handled according to the FAIR (findable, accessible, interoperable and reusable) principle.

FINDABLE	Project outcomes of different type will be uploaded on ZENODO repository (see Chapter 7.5), with a searchable resource. Data and metadata are assigned a unique and persistent identifier.
ACCESSIBLE	All the public data and metadata will be accessible on the project website. Confidential data are retrievable by their identifier using a standardized communications protocol
INTEROPERABLE	Data and metadata use a formal, accessible, shared, and broadly applicable language for knowledge representation.
REUSABLE	The data collected and generated during the lifetime of the project will be useful to different typology of stakeholders such as: <ul style="list-style-type: none"> <li>• ERSAT GGC consortium;</li> <li>• European GNSS Agency;</li> <li>• European Commission services and European Agencies;</li> <li>• EU National Bodies;</li> <li>• The general public including the broader scientific community</li> <li>• Stakeholders</li> <li>• Future H2020 (including S2R) projects.</li> </ul>

## 7.2 Collection And Management Of Data Set

The project foresees several activities related to analysis and reporting, and a significant activity of developing and testing of tools, especially regarding WP4 and WP6. Hence, data are both documents and simulations.

This paragraph lists input, ongoing and output data for each WP, as they are expected at the release date of this DMP (Month 6 of the project). Each WP leader is in charge of defining and describing the data set of their own WP, and updating during the project while important changes occur, by informing RFI as Project Coordinator.

For WP relations please refer to §5 of this document.



<b>WP1- Project Coordination and Management</b>		<i>WP Leader: RFI</i>
<b>Input Data</b>	<b>On Going Data</b>	<b>Output Data</b>
Data collected from the Contractual Official documents, i.e. Grant Agreement and official ERSAT GGC Proposal.	Data collected as documentation of the running work of each partner of the Consortium, and data related to the schedule evolution.	Project management data related to the quality of the projects outputs and deliverables, and the management of the data themselves among all the project activities.

<b>WP2- Enhanced ERTMS Specifications and Architecture</b>		<i>WP Leader: ASTS</i>
<b>Input Data</b>	<b>On Going Data</b>	<b>Output Data</b>
Data collected from the Contractual Official documents, e.g. Grant Agreement, Consortium Agreements, etc., and from all the previous projects related to ERTMS + Satellite: ERSAT EAV, NGTC, X2Rail2, SBS, STARS, RHINOS, etc. Data coming from the other WPs, e.g. preliminary Hazard Analysis from WP3. Data collected from the ERTMS specification documents and CENELEC standards, i.e. parameters, thresholds, margins, etc.	Data contained in the intermediate Technical Notes generated in the WP (data related to the Enhanced Functional ERTMS Architecture, ERTMS Operational Scenarios, ERTMS Mission Profile, and Test Specification).	Technical documents that constitute the deliverables (Enhanced Functional ERTMS Architecture and related Test Specification).

<b>WP3- Safety and Hazard Analysis</b>		<i>WP Leader: RINA-C</i>
<b>Input Data</b>	<b>On Going Data</b>	<b>Output Data</b>
Data collected from the Contractual Official documents, e.g. Grant Agreement, etc., and from previous projects related to ERTMS + Satellite, e.g. NGTC. Data coming from the other WPs, e.g. the Enhanced Functional ERTMS Architecture and ERTMS Operational Scenarios from WP2. The ERTMS system requirement specification and the guidelines coming from CENELEC standards for Railways Applications.	Data contained in the drafted deliverables generated by the WP activities.	Technical Analysis and relative Reports that constitutes the WP deliverables.



WP4- Track Survey and Track Classification		WP Leader: DLR
Input Data	On Going Data	Output Data
Data collected from the Contractual Official documents, i.e. Grant Agreement, and from all the previous projects related to ERTMS + Satellite: ERSAT EAV, NGTC, Shift2Rail, STARS, etc.	<p>Information acquired and measured for characterizing the EGNSS SIS with respect to disturbing phenomena, used to classify the track areas as suitable or not suitable for placing virtual balises. The following is a preliminary list:</p> <ul style="list-style-type: none"> <li>• Receiver observations in a proprietary format, to be converted into RINEX-format messages. The receiver data should include at least the following measurements: carrier-to-noise ratio, pseudorange and carrier phase measurements using GPS C/A code signal at L1 frequency and as raw measurement without any iono or tropo model corrections.</li> <li>• When allowed by the receiver, observations as above but obtained by utilizing further GNSS constellations, for example: <ul style="list-style-type: none"> <li>○ GPS L5.</li> <li>○ GLONASS L1</li> <li>○ Galileo E1 and E5.</li> </ul> </li> <li>• Power spectral density.</li> <li>• If the spectrum analyser allows, snapshots of raw sample data.</li> <li>• Video or image data may be acquired (e.g. fish-eye camera pictures)</li> <li>• In-phase and Quadrature-phase correlator outputs.</li> <li>• GNSS samples collected at non-zero IF frequency by RPS (Receive and Playback of Signals) equipment.</li> <li>• GNSS augmentation data.</li> <li>• Constellation almanac data and navigation messages (ephemeris data).</li> <li>• Receiver settings, e.g. elevation mask angle.</li> </ul>	<p>The data produced in WP4 will be defined during WP4.1 and WP4.2. A preliminary list of the possible generated data is:</p> <ul style="list-style-type: none"> <li>• Track Area Classification Data: It consist of information about the classification category (i.e., red, yellow, green) of the different areas of the railway track network under consideration.</li> <li>• Information about the track area classification assumptions and conditions to be taken into account for the railway virtual balise transmission system.</li> </ul> <p>Other WP output data will be the Technical Analysis and relative Reports that constitutes the WP deliverables.</p>



WP5- Assessment of Enhanced ERTMS architecture and of Survey Process and related toolset		WP Leader: BVI
Input Data	On Going Data	Output Data
Data collected from the Contractual Official documents, i.e. Grant Agreement, and as the Output of all the previous WPs	Text type documents containing <ul style="list-style-type: none"> <li>• Issue of technical notes and requests for clarifications on the Input documents.</li> <li>• Minutes and results of technical meetings</li> </ul>	Official Assessment documents containing <ul style="list-style-type: none"> <li>• Evaluation of the activities performed by the partners along the applicable phases of the life cycle defined in the EN50126</li> <li>• Evaluation of the functional architecture defined according to what foreseen in WP 2.1 and amended on the grounds of the results obtained at the end of the activities performed according to the following WP (i.e. 3.1, 3.2)</li> <li>• Evaluation of the test specification defined according to what foreseen in WP 2.2 and amended according to the modifications introduced in the functional architecture as in the above bullet</li> <li>• Evaluation of the safety analysis carried out according to what foreseen in WP 3.x</li> <li>• Evaluation of the Survey Process for Classifying the Track Areas resulted from WP4</li> <li>• Evaluation of the toolset to be used for the evaluation of the Track Areas as in the previous WP 5.2</li> </ul>



WP6- Demonstration		WP Leader: RadioLabs
Input Data	On Going Data	Output Data
<p>The WP needs of the data inputs specified in the following documents:</p> <ul style="list-style-type: none"> <li>• A prototype of the track survey toolset designed, developed, tested and evaluated in WP4 e WP5;</li> <li>• Documents: D4.2 “Technical Specification of Survey Toolset” and D4.3 “Prototype Implementation of the Survey Toolset” from WP4, as guide to use the toolset;</li> <li>• Documents: D4.1 “Procedure Specification Document; D4.4 “Measurement Campaign Report”, D4.5 “Process Execution Report” from WP4, to plan and execute the track survey demonstration;</li> <li>• Document D.7 “Technical Report about system integration in RFI laboratory” from WP4 to plan and execute the integration in RFI laboratory.</li> </ul>	<p>This WP will collect the same kind of data from the track survey and from the simulators that will be configured during the project, according to the Grant Agreement.</p>	<p>Technical Analysis and relative Reports that constitutes the WP deliverables.</p>

WP7- Exploitation and Dissemination		WP Leader: UNIFE
Input Data	On Going Data	Output Data
<p>Data collected from the Contractual Official documents, i.e. Grant Agreement, and from the official ERSAT GGC Proposal.</p>	<p>Collect information related to the dissemination of the project performed by the partners of the Consortium in events, presentations and publication.</p>	<p>Project templates and Logo created to represent the project and unify the documentation of the project such as deliverables, agendas, Minutes of Meetings and slides for presentations. Dissemination material used to present and make stakeholders aware of the project in events and presentations.</p>



### 7.2.1 Expected size of the data

Significant size of data is expected for the track-surveys data collection and the demonstration activities (WP4 and WP6). As a reference number, the average size of acquired RF data for 50km of run is 120GB (minimum 90GB – maximum 155GB), according to tests performed in the STARS project. Raw data from the receiver amount to 300MB for the same track.

The size will be scaled according to the number of surveys, the length of the tracks and the number of simulations performed. More details will be provided once the test plan will be defined.

Dedicated mass storage shall be foreseen.

## 7.3 Data Set Reference And Name

File naming will be coherent with the coding structure defined in the ERSAT GGC Quality Plan (Ref 3), §5.2.2 “Document Management in the Cooperation Tool”.

The identification code contains the six following sections:

[PROJECT] – [DOMAIN] – [TYPE] – [OWNER] – [NUMBER] – [VERSION]
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where:

- [Project] is GGC for all ERSAT-GGC documents;
- [Domain] is the relevant domain in the Cooperation Tool (WP, Task or project body);
- [Type] is one letter defining the document category;
- [Owner] is the trigram of the deliverable leader organisation;
- [Number] is an order number allocated by the Cooperation Tool when the document is first created;
- [Version] is the incremental version number, automatically incremented at each upload.

## 7.4 Data Security And Integrity

All the data and documents handled and produced within ERSAT GGC project will be stored in the Cooperation Tool (refer to the Quality manual for further information). For access to the project repository, users are provided with a username (e-mail address) and password. The access to the Cooperation Tool and the related rights are set by the Project Coordinator (RFI) with the support of RINA-C.

## 7.5 Data Sharing

The ERSAT GGC consortium is committed to the mandate for open access of publication in the H2020 programme as well as to the participation in the Pilot for Open Research Data.

The public website (<http://www.ersat-ggc.eu/>) includes a sharing area, where public documents/deliverables will be stored.

According to the accessibility of all data set to the scientific community, the ERSAT GGC Consortium will also use ZENODO (<https://zenodo.org/>) as another data repository and scientific publication for project outcomes. Not protected scientific results that are useful for public use will be uploaded in ZENODO repository accordingly. All uploaded material will be made available free of charge.





The list of the documents can be further expanded in case there is a need for that. At this stage the following documents were identified:

- Electronic copies of the final version manuscript accepted for publication;
- Publications made available immediately by open access publishing. Publications that past embargo period;
- Public deliverables;
- Public summaries of the confidential deliverables (only in case of agreement of public summary for a confidential deliverable);
- All external dissemination material;
- Videos/audio and interactive materials such as lessons;
- Research data need to validate the results presented in the publication.

ZENODO also assigns a Digital Object Identifier (DOI) to all publicly available uploads, in order to make content easily and uniquely citable.

## **7.6 Ethical Aspects**

ERSAT GGC does not process personal data as a part of the research activities.

# **8. ALLOCATION OF RESOURCES**

RFI, in its role of ERSAT GGC project coordinator is responsible for generating the first version of DMP and the following versions if needed. Moreover, RFI is responsible for the implementation of the Data Management Plan (DMP).

All consortium partners are responsible for the data generation as well as data quality in the respective WPs and tasks, as included in the description of work (DoW). According to the Consortium Agreement, each partner is in charge of the storage and management of the data related to their activities inside the project.

UNIFE is in charge of the website development and management, and it is - along with RFI - the main responsible for the dissemination activities.

RINA-C is responsible for the correct management of the Cooperation Tool.

## **8.1 Resources For Delivering The DMP**

The main resources needed for the correct implementation of the DMP are all at hand and easily accessible. Cooperation Tool, website and ZENODO can be considered as the main tools to be used for the implementation of the plan.





## 9. CONCLUSIONS

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This document contains the first release of the “DMP” and represents the status of the mandatory quality requirements at the time of deliverable D1.2

This report should be read in association with all the referenced documents, appendix material and including the EC Grant /Consortium Agreement, annexes and guidelines.

The report will be subject to revisions as required to meet the needs of the ERSAT-GGC project.

## REFERENCES

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- [1]. ERSAT GGC Grant Agreement 776039 (GA and all the annexes)
- [2]. Consortium agreement of ERSAT GGC (776039), version 2, 13-11-2017
- [3]. ERSAT GGC Quality Plan, “ERSAT-GGC\_WP1\_D1.1\_Quality Plan\_v2”, 06/04/2018

