ENHANCED INTERFACES AND TRAIN CATEGORIES FOR DYNAMIC COMPATIBILITY ASSESSMENT OF EUROPEAN RAILWAY BRIDGES

D7.2 – Data Management Plan

DELIVERABLE INFORMATION	
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Deliverable title:	Data Management Plan
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PUBLICATION HISTORY

Revision	Date	Description	Responsible
V1	31-07-2024	Initial version	Pedro Montenegro / UPORTO
V2	26-03-2025	Revised version after comments from the Reviewers sent on 18-02-2025 and minor comments from the JU on 24-03-2025	Pedro Montenegro / UPORTO

CONTRIBUTORS TO THE DELIVERABLE

Name	Institution	Role
Pedro Montenegro	UPORTO	Deliverable responsible

PROJECT CONSORTIUM

Coordinator	*Universidade do Porto* *UPORTO, Portugal*	
Beneficiaries	*Kungliga Tekniska Hoegskolan* *KTH, Sweden*	
	Universidad Politecnica de Madrid *UPM, Spain*	
	Bundesanstalt für Materialforschung und -Prüfung *BAM, Germany*	
	Deutsche Bahn InfraGO AG *DB, Germany*	
	Acoustique Et Vibrations Logiciels Scientifiques *AVLS, France*	
Affiliated Partners (to UPM)	*Universitat Politecnica de Valencia* *UPV, Spain*	
	Universitat Jaume I de Castellon *UJI, Spain*	
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TABLE OF CONTENTS

LIST OF ABBREVIATIONS

API: Application Programming Interface

CEN: European Committee for Standardization

DER: Decomposition of Excitation in Resonance method

Dx.y: Deliverable number y from Work Package x

D&E&C: Dissemination, exploitation and communication

DMP: Data Management Plan

DTC: Dynamic Train Category

DZSF: German Centre for Rail Traffic Research (*Deutsches Zentrum für Schienenverkehrsforschung*)

EOSC: European Open Science Cloud

ERA: European Union Agency for Railways

EU: European Union

EU-Rail: Europe's Rail Joint Undertaking

FAIR: Findable, Accessible, Interoperable and Re-usable

GA: Grant Agreement

HTTPS: Hypertext Transfer Protocol Secure

IPR: Intellectual Property Rights

LIR: Residual Influence Line method

MSx: Milestone number x

PDF: Portable Document Format

PO: Project Officer

PU: public deliverable

SEN: sensitive deliverable

SSL: Secure Sockets Layer certificate

WP: Work Package

1 EXECUTIVE SUMMARY

The present deliverable D7.2 is included within Work Package 7 (WP7) entitled *"Technical coordination, scientific quality assurance and dissemination, exploitation and communication"* related with the management of the project (see Figure 1) and aims to describe how research data developed within InBridge4EU will be managed. This plan will be used as a guiding document to ensure good data management throughout the lifecycle of the project in order to make the information collected and produced Findable, Accessible, Interoperable and Re-usable (FAIR).

The document is structured in several sections that follow the template for a Data Management Plan (DMP) proposed by Horizon Europe. After the presentation of the executive summary of the present deliverable in Section 1, a summary of the data involved in the InBridge4EU project is presented in Section 2. Then, Section 3 shows how the data will follow the FAIR principles, Sections 4 and 5 describe the resources allocated to gather the data and how it will be secured, respectively, and Section 6 presents the ethical aspects involved. Finally, Section 7 is reserved to identify other issues that may arise, while Section 8 presents the conclusions from the present report.

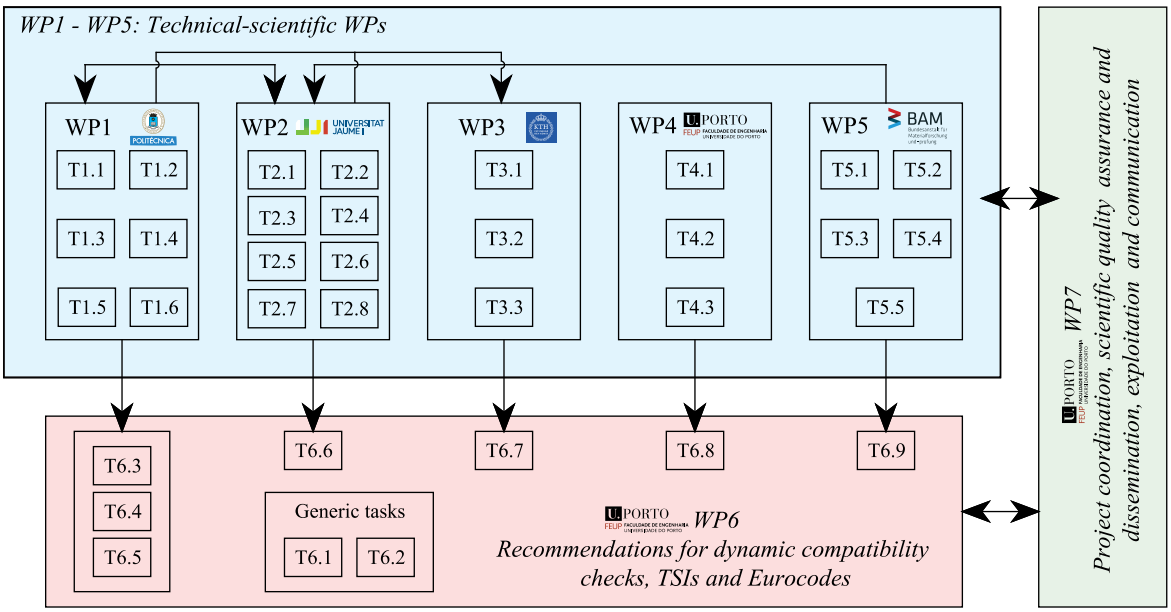

Figure 1: Project's structure with the connection of WP7 with the remaining technical WPs.

2 DATA SUMMARY

InBridge4EU bases its research activities on the Horizon Europe open science practices (EU Open Science, 2021) to establish open science as the basic way of working for all research carried out in this project. The open science activities start at the consortium level and are further developed at the European level to make the research methods and results available to the public. According to EU Open Science (2021), the activities consist of *"sharing knowledge, data and tools [...] in open collaboration with all relevant knowledge actors"*, coming from academia, industry or the public and extending to the societal level. The open science guidelines will manifest themselves in the present DMP and lead to a high potential for quality, efficiency, and impact of the project's research, as well as responding to the needs of society and the recognition of a credible science system. Concrete actions and activities of open science practices of the consortium are:

- Immediate open access to all scientific publications via open-access publications with peer review as standard publication form, mainly supported by shared raw data and used methods and algorithms, contributing to the development of the European Open Science Cloud (EOSC).
- Information about publications and findings via a website of the consortium related to this project and its research scopes for the European public society.
- Research data management according to the FAIR principles (Wilkinson et al., 2016).
- Collection and classification of data from different sources in combination with metadata to classify, describe and make the data available in an appropriate form to different stakeholders, while ensuring legitimate interests or constraints.

InBridge4EU will re-use and produce data in different formats. Basically, it can be divided into three main types, namely databases, public deliverables and scientific publications, which are described in more detail in the following subsections.

2.1 Public Deliverables

The InBridge4EU deliverables will be produced and stored in PDF format (except the Rolling Stock and Bridges databases included in D1.1 and D2.1, respectively, which will be described in more detail in Section 2.3). Each deliverable, whose templates were already described in the Deliverable 7.1 – *Dissemination, exploitation and communication (D&E&C) plan* and made available for all the consortium, must provide the following information:

- An executive summary describing the general contents of the deliverable.
- Name of the responsible for the deliverable and respective institution.
- Publication history table identifying the different versions of the document
- Due dates and actual submission dates.
- Relation to the respective Work Package (WP).

InBridge4EU has a total of 16 deliverables (see Table 1), with only 2 of them with restricted access (SEN – Sensitive) and 14 with open access (PU – Public). All the public deliverables will be made available in the project's website www.inbridge4eu.eu. Regarding the sensitive ones, although the content of the databases included in the deliverables D1.1 and D2.1 are restricted, a simplified document explaining the main contents of those databases will also be made available on the website.

2.2 Scientific publications

According to the Article 17 of the Grant Agreement (GA) ("Communication, dissemination, open science and visibility"), the beneficiaries of the project must ensure open access to peer-reviewed scientific publications relating to the results. InBridge4EU will ensure this procedure by publishing all the scientific papers in open access journals or by paying the necessary fees to make them open accessible. Moreover, as for the public deliverables and after acceptance from the journals, the consortium will deposit in the project's website www.inbridge4eu.eu. All the publications that will arise from the project will include a statement with acknowledgement to the InBridge4EU project (see dissemination rules in the Deliverable D7.1). These documents will be stored in PDF format.

2.3 Databases

InBridge4EU will produce two main databases included in the deliverables D1.1 - Database of rolling stock and definition of critical parameters and D2.1 - Bridge database. While the first one will be stored in a MATLAB® (2023) structure format, the latter will be stored in a online cloud through an application developed in Python on architecture cloud services, seamlessly integrated with PostgreSQL for robust data management.

All these databases are made based on background data from partners of the consortium and from outside it. Regarding the Rolling Stock database, this data comes from rolling stock manufactures (CAF, SIEMENS, ALSTOM) and from databases from pervious projects, including In2Track3 (2023) and DZSF (2023). With respect to the bridge database, which includes technical information of 500 bridges from 5 European countries and experimental measurements from some of them, the data will be organized in a cloud application (https://computeruse.us.es/inbridge4eu/index), but with restricted access to the consortium, project's advisory board, EU-Rail, ERA and CEN, as specified in Article 16 of the GA ("Intellectual Property Rights (IPR) - Background and results - Access rights and rights of use"). Such restrictions are mandatory by the data providers, in this case the Infrastructure Managers, namely DB InfraGo, ADIF, SNCF, Infraestruturas de Portugal and Trafikverket. Nevertheless, a simplified document explaining the main contents of these databases will be made publicly available on the project's website. Moreover, the final results from both WP1 and WP2, to which these databases pertain, will be made publicly available in the remaining deliverables, in which representative data at European level can be appropriately presented in normalised/anonymous form, while preserving national safety interests.

Table 1: List of deliverables in InBridge4EU and the respective responsible, dissemination level and due date.

Number	Name	WP	Responsible	Dissemination Level	Due Date
D1.1	Database of rolling stock and definition of critical parameters	WP1	HUD	SEN	31-May-25
D1.2	Limitations of DER/LIR and improved spectral methods	WP1	UPV	PU	31-Dec-25
D1.3	Dynamic Train Categories	WP1	UPM	PU	28-Feb-26
D1.4	Limits of validity of static compatibility checks	WP1	DB InfraGO	PU	31-Aug-26
D2.1	Bridge database	WP2	UJI	SEN	31-Aug-24
D2.2	Worst-case combination of critical parameters of existing bridges	WP2	UJI	PU	30-Apr-26
D2.3	Economic evaluation of the proposed DTCs	WP2	UJI	PU	31-Aug-26
D3.1	Revised formulae for the dynamic factors φ' and φ''	WP3	KTH	PU	31-Aug-26
D4.1	Revision of damping	WP4	UPORTO	PU	28-Feb-25

Number	Name	WP	Responsible	Dissemination Level	Due Date
D5.1	Revised acceleration criteria for railway bridges with ballastless tracks	WP5	UPORTO	PU	28-Feb-25
D5.2	Revision of the acceleration limits in bridges with ballasted tracks	WP5	BAM	PU	31-Aug-25
D6.1	Recommendations for updating Eurocodes and TSIs	WP6	UPM	PU	31-Aug-26
D7.1	D&E&C plan	WP7	UPORTO	PU	29-Feb-24
D7.2	Data management plan	WP7	UPORTO	PU	31-Aug-24
D7.3	Project coordination mid-term report	WP7	UPORTO	PU	30-Apr-25
D7.4	Project coordination final report	WP7	UPORTO	PU	31-Aug-26

3 FAIR DATA

3.1 Making data findable

InBridge4EU will store all the data internally in a collaborative SharePoint in MS OneDrive® (2024) accessible to all the consortium, advisory board and members from EU-Rail, ERA and CEN. After acceptance (deliverables or scientific publications), the documents will be made available in the project's website www.inbridge4eu.eu. All documents will be organized with a specific naming, which described the document number and version (e.g. "InBridge4EU_Deliverable_7.2_V1"). Each document (deliverable, milestone report, etc) has in its front page the project's logo and title, the report title and a table with the necessary metadata to be easily identified, while the second page contains the history of changes table. Finally, in the third page, all the consortium is identified through the respective name and logo and the acknowledgement and disclaimer is presented, as shown in Figure 2.

Table 2: Information table in reports.

REPORT INFORMATION	
Work package number:	WPx
Work package title:	WP title to which the report is associated
Report number:	Report: Rx / Deliverable: Dx.1 / Milestone: MSx
Report title:	Report/Deliverable/Milestone title
Due date of deliverable:	DD-MM-YYYY
Actual submission date of the 1st version:	DD-MM-YYYY
Current version submission date:	DD-MM-YYYY
Responsible partner	Short name of the responsible partner (e.g. UPORTO)
Revision:	V1
Dissemination level:	PU

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Figure 2: Acknowledgement and disclaimer presented in the third page of the reports.

3.2 Making data accessible

As expressed above, most produced data will be openly available as the default, with the exception of the Rolling Stock and Bridge databases. The deliverables marked as PU – Public (see Table 1) will be openly available in the project's website www.inbridge4eu.eu after acceptance of the Project Officer (PO). All the scientific publications will be published in open access format and, after acceptance, will also be stored in the project's website.

Regarding the databases of Rolling Stock (D1.1) and Bridges (D2.1) marked as SEN – Sensitive, these will be shared under restricted access conditions only accessible to the consortium, advisory board, EU-Rail, ERA and CEN. Such restriction is specified in Article 16 of the GA ("Intellectual Property Rights (IPR) - Background and results - Access rights and rights of use"), through the following point:

- *In Horizon Europe actions, the beneficiaries which have received funding under the grant must grant access to their results — on a royalty-free basis — to the granting authority, EU institutions, bodies, offices or agencies for developing, implementing and monitoring EU policies or programmes. Such access rights do not extend to beneficiaries' background.*

For accesses outside the consortium or the aforementioned bodies, only representative data at European level can be presented in normalised/anonymous form upon request, while preserving national safety interests. The whole information presented in the database must remain confidential due to restrictions imposed by the data providers, in this case the Infrastructure Managers, namely DB InfraGo, ADIF, SNCF, Infraestruturas de Portugal and Trafikverket. Nevertheless, as mentioned before, a simplified document explaining the main contents of these databases will be made publicly available on the project's website.

3.3 Making data interoperable

Data will be defined into a domain specific standard, if applicable. The database is accessible from external applications such as MATLAB® (2023) and Python. To access the database from external applications is needed to authenticate by the user's API token. Information about the process can be found at https://...documentation/MATLAB/ and https://...documentation/python/. Experimental data from the bridge database can be downloaded in GNU zip (gz) compressed files. This type of file has been chosen for the high compression ratio. Once the gz file is uncompressed, the experimental data is obtained in binary files. Several programs can be used to uncompress the gz files. Binary files are used to store experimental data in a compact form. The gz files can be uncompressed and the binary files can be read by the MATLAB® (2023) and Python programming languages

3.4 Increase data re-use

In general, data produced in InBridge4EU will be made openly available as soon as scientific papers are accepted by the journals and deliverables accepted by the PO. Furthermore, definitive decisions in relation to the publishing/sharing of data with regards to licenses can only be decided upon once the selection of data sources has been finalized and thoroughly evaluated.

4 ALLOCATION OF RESOURCES

All the data is internally stored a collaborative SharePoint in MS OneDrive® (2024) financially supported by the project coordinator UPORTO. Upon acceptance, when the deliverables and scientific publications are accepted, they will be made available in the project's website, whose domain is also being financially supported by UPORTO. Regarding the bridge database, the data is stored in the UdS servers free of costs.

5 DATA SECURITY

The internal data stored in the collaborative SharePoint in MS OneDrive® (2024) is protected through backups and can only be accessed with the authorization of the Sharepoint's owner, in this case UPORTO thus preventing access to non-authorized users.

Regarding the bridge database, it can be accessed through a username and password authorized by the responsible for the database development UdS. The implementation of a virtual private cloud ensures enhanced security measures, complemented by SSL certificate integration and HTTPS redirection, safeguarding sensitive data transmissions effectively. Users can securely access the system using user login credentials and API tokens, with group permissions facilitating control over access levels and functionalities.

6 ETHICS

Ethical aspects specified in Article 14 of the GA should be fully respected throughout the project, including in the way data is managed and/or shared. In the InBridge4EU projects, no ethical constraints have been identified, namely within the topics of Human Embryonic Stem Cells and Human Embryos, Humans, Human Cells / Tissues, Personal Data, Animals, Environment, Health and Safety and Artificial Intelligence. The beneficiaries commit to ensuring that all ethics issues related to activities in the grant are addressed in compliance with ethical principles, the applicable international and national law, and the provisions set out in the GA. This includes the ethics issues identified in this ethics summary report and any additional ethics issues that may emerge in the course of the grant. In case any substantial new ethics issues arise, the beneficiaries commit to informing the granting authority.

7 OTHER ISSUES

All beneficiaries/partners from the consortium should process personal data under the GA in compliance with the applicable EU, international and national law on data protection, in particular with Regulation (EU) 2016/679 (2016). According to this regulation, which is addressed in Section 15.2 from the GA, all beneficiaries/partners must ensure that any personal data is handled with the following precautions:

- Processed lawfully, fairly and in a transparent manner in relation to the data subjects.
- Collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes.
- Adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed.
- Accurate and, where necessary, kept up to date.
- Kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the data is processed and

- Processed in a manner that ensures appropriate security of the data.

The beneficiaries/partners may grant their personnel access to personal data only if it is strictly necessary for implementing, managing and monitoring the GA. The beneficiaries/partners must ensure that the personnel are under a confidentiality obligation and must inform the persons whose data are transferred to the granting authority and provide them with the Portal Privacy Statement.

8 CONCLUSIONS

The present deliverable presents the DMP adopted in InBridge4EU, which is addressed in the project's WP7 led by UPORTO entitled *"Technical coordination, scientific quality assurance and dissemination, exploitation and communication"*.

First, the type of data used and created within the project has been identified and characterized, namely in terms of deliverables, scientific publications and databases. Then, the way this data will be managed according to the FAIR principles has been presented. Data will be, in general, openly accessible and findable through the project's webpage.

The present document also makes a brief description about the allocated resources related with data management, the actions to ensure its security and a ethics self-statement.

9 REFERENCES

DZSF (2023). Development of a dynamic load model for bridge structures. Retrieved from https://www.dzsf.bund.de/SharedDocs/Standardartikel/DZSF/Projekte/Projekt_28_dynamisches_lastenmodell.html

EU Open Science (2021). *Horizon Europe, open science : early knowledge and data sharing, and open collaboration,* European Commission. Directorate-General for Research and Innovation. Publications Office of the European Union. Brussels. Retrieved from https://data.europa.eu/doi/10.2777/18252

In2Track3 (2023). Research into optimised and future railway infrastructure. Retrieved from https://projects.shift2rail.org/s2r_ip3_n.aspx?p=IN2TRACK3

MATLAB®. (2023). Natick, MA, USA: Release R2023a, The MathWorks Inc.

MS OneDrive®. (2024). *Microsoft® OneDrive® for Microsoft 365 MSO*. Redmond, WA, USA: Version 2401 Build 16.0.17231.20194.

Regulation (EU) 2016/679 (2016). *Regulation (EU) 2016/679 of the European parliament and of the council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing directive 95/46/EC (GDPR - General Data Protection Regulation)*, Official Journal of the European Union. Brussels. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0679

Wilkinson, M. D., Dumontier, M., Aalbersberg, I. J. J., Appleton, G., Axton, M., Baak, A., Blomberg, N., Boiten, J.-W., da Silva Santos, L. B., Bourne, P. E., Bouwman, J., Brookes, A. J., Clark, T., Crosas, M., Dillo, I., Dumon, O., Edmunds, S., Evelo, C. T., Finkers, R., Gonzalez-Beltran, A., Gray, A. J. G., Groth, P., Goble, C., Grethe, J. S., Heringa, J., Hoen, P. A. C., Hooft, R., Kuhn, T., Kok, R., Kok, J., Lusher, S. J., Martone, M. E., Mons, A., Packer, A. L., Persson, B., Rocca-Serra, P., Roos, M., van Schaik, R., Sansone, S.-A., Schultes, E., Sengstag, T., Slater, T., Strawn, G., Swertz, M. A., Thompson, M., van der Lei, J., van Mulligen, E., Velterop, J., Waagmeester, A., Wittenburg, P., Wolstencroft, K., Zhao, J., & Mons, B. (2016). The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data, 3*, 160018. doi:10.1038/sdata.2016.18